

VOLUME 2 OF 3 – APPENDICES A, B AND C

**HOMESTAKE MINING COMPANY OF CALIFORNIA
GRANTS RECLAMATION PROJECT**



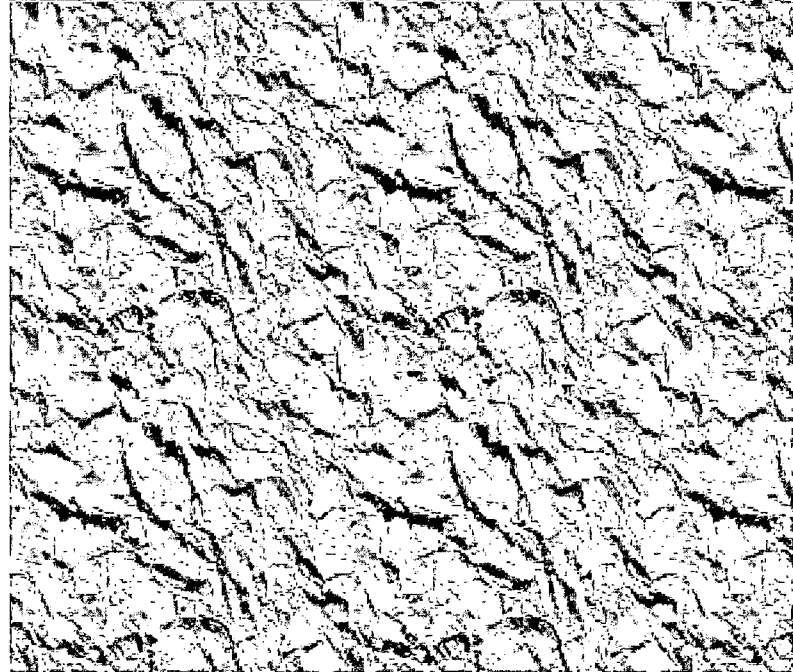
GROUNDWATER CORRECTIVE ACTION PROGRAM

DECEMBER 18, 2019

**U.S. NUCLEAR REGULATORY COMMISSION LICENSE SUA-1471
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Appendix A
Groundwater Compliance Monitoring Plan

**SECOND INTERIM DRAFT Geochemical Characterization of
Tailings, Alluvial Solids and Groundwater
Grants Reclamation Project**



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August 2019**

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LIST OF ATTACHMENTS

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Drilling Completion Memorandum

Attachment 2

Tailings and Alluvial Water Quality Data (to be provided in final report)

Attachment 3

DCM Science XRD and SEM Mineralogy Reports

Attachment 4

Humidity Cell Testing Results (to be provided in final report)

Attachment 5

LTP Static Column Testing Results (to be provided in final report)

EXECUTIVE SUMMARY

This second interim draft geochemical characterization report presents geochemical testing results for the LTP tailings and surrounding San Mateo Creek alluvial aquifer. The objectives are to advance the assessment of potential post-flushing rebound of COC concentrations in the Large Tailings Pile (LTP) and to provide adequate characterization of tailings and alluvial aquifer properties to support the current conceptual model and to provide information needed for reactive transport modeling of the main constituents of concern (COC): uranium (U), molybdenum (Mo), and selenium (Se). The LTP contains elevated pH, TDS, and is dominated by sodium and sulfate result from the alkaline milling process. The LTP pore water is only slightly reducing such that Se is predicted to occur primarily as reduced selenite (SeO_3^-), while U and Mo exists primarily in their mobile oxidized forms (U-carbonate complexes and MoO_4^{2-}). Tailings solids are composed primarily of quartz and feldspar, with lesser amounts of smectite, kaolinite, calcite, and minor pyrite and iron oxide. Selenium was the most abundant COC identified in the solids, found in association with pyrite and as reduced native Se. Uranium was commonly observed in association with calcium and vanadium, while no distinct Mo-bearing phases were identified. The tailings contain pyrite but are net acid neutralizing and thus not expected to become acidic upon future weathering. A 20-week duration humidity cell tests did not indicate any significant release of iron, sulfate, uranium, molybdenum, or selenium from the tailings solids. A multi-faceted approach to evaluating LTP rebound considers trends in existing tailings wells, tailings sumps, controlled column tests, and new wells with shorter screens which will be evaluated in the final report. Although a few select sumps and former rebound monitoring wells have demonstrated increasing COC concentrations since flushing ceased the volume-weighted concentrations of uranium, molybdenum, and selenium in the LTP have been decreasing since flushing ceased. In addition, results from the controlled column study provided no indication of diffusive rebound over a 1-Year test period.

The alluvial groundwater is comparatively more oxidizing compared to the LTP. Alluvial solids are mainly composed of quartz, feldspar, and calcite. Pyrite is generally absent and the alluvium contains low contents of amorphous iron hydroxide and a low clay content. Geochemical modeling indicates that dissolved Se exists as the oxidized selenate species (SeO_4^{2-}), U as negatively charged carbonate complexes, and Mo as MoO_4^{2-} . These oxidized forms of COC are referred to as oxyanions which are not strongly attenuated by clays or iron oxides and therefore are generally mobile in the environment. The information collected to date regarding redox conditions, water quality, and mineralogic composition of the alluvial aquifer solids are currently being used in development of a reactive transport model for the Site. Following completion of the remaining geochemical testing (LTP well and sump monitoring), a final report will be submitted in which all tailings/alluvial groundwater data will be presented, and a final assessment of tailings source term and rebound evaluations will be completed.

1.0 INTRODUCTION

Homestake Mining Company (HMC) has managed a groundwater restoration program since 1977 at the Grants Reclamation Project Site (Site) in Cibola County, New Mexico, with the goal of reducing concentrations of constituents of concern (COCs) in underlying aquifers (primarily the San Mateo Creek alluvium) to levels meeting Site standards. Prior flushing, extraction, and reinjection activities have proven effective in reducing concentrations of the primary COCs uranium (U), molybdenum (Mo), and selenium (Se) in tailings, and the areal extent of alluvial contaminant plumes. HMC is currently working toward Site closure through the development of hydrologic and geochemical models to evaluate post-closure fate and transport of COCs. In 2017, HMC requested that Worthington Miller Environmental (WME) develop and implement a geochemical characterization program (WME, 2018a) to collect the information needed to develop a Site-wide conceptual geochemical model and to better understand the influence of uranium mill tailings and aquifer characteristics on groundwater COC transport.

The current version of this report serves as the second Interim Draft Geochemical Characterization Report for HMC's internal review according to the schedule outlined in the Draft Geochemical Characterization Workplan (WME, 2018a). Completion of this work is pending the final analyses from LTP sumps and new LTP monitoring wells as part of the LTP rebound assessment. A final report will be submitted in September 2020 (WME, 2018a).

1.1 RATIONALE AND OBJECTIVES

To develop a comprehensive conceptual Site model and to effectively simulate groundwater COC transport, it is necessary to characterize the geochemical properties of the tailings contaminant source, the underlying groundwater, and the aquifer mineralogy. To assess contaminant transport, regulatory guidance stipulates that geochemical conditions be sufficiently characterized to: (1) Properly estimate the source term, (2) characterize the subsurface geochemical properties, and (3) identify contaminant attenuation mechanisms (USNRC, 2003). Consequently, WME developed and implemented a Geochemical Work Plan (WME, 2018a) to better understand the water quality, solid-phase composition, and oxidation-reduction (redox) conditions in the Large Tailings Pile (LTP), Small Tailings Pile (STP), and underlying San Mateo Creek (SMC) alluvial aquifer.

The overall objectives of the geochemical evaluation are to advance the assessment of potential post-flushing tailings rebound and to provide adequate characterization of tailings and aquifer properties to support the Site conceptual model and post-closure COC reactive transport modeling. This comprehensive evaluation includes detailed characterization of water quality and solids geochemistry for both tailings and alluvial aquifer solids to: (1) Assess potential future rebound of COC's in the Large Tailings Pile (LTP), (2) define LTP and Small Tailings Pile (STP) source term characteristics, and (3) characterize alluvial aquifer properties and potential COC attenuation mechanisms (WME, 2018b).

1.2 FIELD SAMPLING PROGRAM

The geochemical field sampling program consisted of detailed water quality and solid-phase testing of tailings and alluvium, utilizing both existing monitoring wells and through the installation of additional monitoring wells and/or borings. Between June 13th and June 25th 2018, six monitoring wells were installed in the LTP, two monitoring wells were installed in the STP, and seven borings

were drilled into the alluvial aquifer for solids and/or water quality sample collection. Details regarding all monitoring well drilling and sampling are provided in Attachment 1.

1.2.1 Tailings and Alluvial Solids

The LTP monitoring well borings included three sand (WME-1 through WME-3) and three slime locations (WME-4 through WME-6) where wells were installed and solids were collected for geochemical testing (Figure 1). Two additional borings (WME-7 below LTP sands and WME-8 below LTP slimes) obtained samples of underlying alluvium from an upper perched zone and a lower vadose zone (Figure 1). Samples of the STP solids were collected during the installation of monitoring wells in the underlying alluvium (WME-9 and WME-10) (Figure 2). The seven remaining borings originally proposed for saturated-zone alluvial solids collection (WME, 2018a) are shown on Figure 3 (it should be noted that saturated alluvium could not be collected from locations WME-12 and WME-13 because the drill stem hit refusal on igneous bedrock before groundwater was encountered). Samples are referred to as North Alluvium (background, WME-11), South Alluvium (prior tailings influences, WME-14 and WME-15), and Adjacent Alluvium (strong tailings influence, WME-16 and WME-17). Table 1 summarizes all tailings and alluvial solids sample collection and associated geochemical testing. A more detailed description of the testing objectives and procedures is provided in subsequent sections of this report.

1.2.2 Tailings Water and Alluvial Groundwater

The locations for detailed tailings water quality evaluation includes: (1) New LTP wells WME-1 through WME-6 with short screen lengths (5'), (2) a series of existing Arcadis LTP wells (WE9, WF2, WF9, WF11) located in the extended shutdown area, used in a previous tailings rebound evaluation (Arcadis, 2012), and (3) six LTP toe drain (sump) locations (North Sump 1, North Sump 3, East Sump 1, East Sump 2, West Sump 1, South Sump 1) (Figure 1). The LTP tailings locations were subjected to frequent sampling for COCs and redox indicators according to a Standard Operating Procedure (WME, 2018c) for the purpose of characterizing the geochemical conditions of the tailings and to evaluate potential post-flushing rebound in COC concentrations. Saturated conditions do not exist within the STP and therefore no monitoring wells were screened directly within the STP.

The locations for detailed alluvial groundwater sampling includes the two new wells WME-9 and WME-10 completed in alluvium underlying the STP (Figure 2), in addition to the following 13 existing Site monitoring wells categorized with respect to their location relative to the LTP (Figure 3): (1) North alluvial (background) wells (DD, R, Q), (2) west alluvial wells (S4, M19, MR), (3) south alluvial wells (D1, X, F, I), and (4) LTP underlying alluvial wells (T2, T20, T22). A summary of all tailings and alluvial monitoring well completion information, sampling frequencies, and water quality analyses is provided in Table 2.

2.0 TAILINGS SOURCE TERM CHARACTERIZATION

The chemistry and mineralogy of LTP and STP tailings solids has not been previously evaluated, nor have the detailed chemistry and associated redox conditions within the tailings water been adequately characterized. Geochemical testing is used to identify the specific solid-phase and dissolved forms of COCs and major mineralogical characteristics of the tailings, which ultimately controls the long-term chemical behavior and potential future release of COCs from the LTP and STP.

The predominant factors controlling the forms of dissolved COCs in the LTP are typically the major ion chemistry, pH, and redox conditions.

2.1 TAILINGS WATER QUALITY AND REDOX CONDITIONS

Information regarding detailed water quality and redox conditions in the LTP were collected in conjunction with the LTP concentration rebound assessment (Section 4.0). All water quality and field parameter results are contained in Attachment 2. The LTP wells and sumps have been analyzed for field parameters (pH, conductivity, temperature, ORP, and dissolved oxygen) and a full suite of major ions and trace metals according to the schedule in Table 2. Because adequate information for geochemical characterization had been collected from the Arcadis wells and the LTP sumps by the end of 2018, their analyte list was reduced to only chloride, molybdenum, uranium, and selenium for the ongoing concentration rebound evaluation (Section 4.0).

The major ion water quality for the LTP wells and sumps are plotted using a trilinear diagram on Figure 4 (only 2018 data are shown for clarity). The tailings water is classified as a Na-SO₄ type water (except for Well WME-5 which is a Na-CO₃ type water) due to the use of sodium carbonate/bicarbonate, sodium hydroxide, and sulfuric acid in the milling process (Skiff and Turner, 1981). Uranium was recovered from the ore using an alkaline leach and thus the tailings wells and sumps generally contain elevated pH (Figure 5). Chemical addition and evapoconcentration of tailings water in the former ponds resulted in elevated total dissolved solids (TDS) concentrations, which tend to be more elevated in the sumps and new LTP wells (WME-1 through WME-6) compared to the Arcadis wells which are partially screened in the underlying alluvium.

Redox conditions in the LTP were evaluated by assessing dissolved oxygen (DO) content, measured redox potential (Eh), and the concentrations of various redox indicators. Redox potential expressed as Eh is required for geochemical calculations and is calculated based on field ORP measurement of the sample in conjunction with a redox standard (Zobell's Solution) (USGS, 2005). However, Eh measurements are sometimes unstable and only of qualitative value unless the system is completely anoxic (devoid of DO) and dominated by iron, sulfur, and manganese (Langmuir, 1997). Therefore, analysis for additional redox "couples" was conducted to assess the redox status of the groundwater, including the dissolved species of iron (Fe²⁺/Fe³⁺), nitrogen (NH₄⁺/NO₃⁻), sulfur (H₂S/SO₄).

The relationship between the various forms of redox indicators and the Eh is shown using the concept of a "redox ladder" (Figure 6). In natural waters, atmospheric oxygen is the major oxidant and organic matter is the major reductant. During the decay of dissolved organic carbon (DOC) in groundwater isolated from the atmosphere (aerobic decay), DO becomes depleted and the Eh drops. If the rate of oxygen depletion is greater than the rate of oxygen replenishment, anaerobic conditions are established. The redox ladder on Figure 6 shows that once the DO is depleted, the progressive reduction of nitrate, selenium, manganese, iron, uranium, and sulfate occurs with decreasing Eh. The tailings water (new LTP wells and sumps) contains an average DOC concentration of 13 mg/L which is adequate to produce anoxic conditions (Langmuir, 1997). The DO concentrations in the tailings ranged from 0.87 to 11.4 mg/L (Figure 7) and are generally higher compared to the Arcadis wells which are partially screened in the underlying alluvium. Consequently, Eh values also indicate more oxidizing conditions in the sumps and LTP wells compared to the Arcadis wells (Figure 7).

The low DO concentrations in some wells (Figure 7) indicate that DO is being consumed by organic decay, causing the reduction of nitrate to ammonia (Figure 8). Measurable hydrogen sulfide (H_2S) is also present in some wells (Figure 8). The presence of both reduced nitrogen and sulfur species in conjunction with low DO concentrations indicates the heterogeneous nature of the tailings which apparently contain zones that are both oxidizing and reducing. These zones become mixed during well purging and produce waters containing both measurable DO and more reduced nitrogen and sulfur species. Although some ferrous iron (Fe^{+2}) would also be expected in these waters (Figure 6), most values were below detection (<0.02 mg/L), but manganese was detected at low concentrations (0.002 to 0.392 mg/L) (Attachment 2). The redox classification scheme developed for groundwaters (Langmuir, 1997) in Table 3 shows that measurable DO generally indicates an "oxic" or "suboxic" environment, whereas its absence indicates an "anoxic" environment. Anoxic systems are further divided into those with or without measurable sulfide ("sulfidic" and "nonsulfidic"). The overall redox status of the LTP can be categorized as oxic to suboxic, although the presence of low sulfide concentrations suggests the existence of some anoxic sulfidic zones.

Field measured Eh values from the LTP wells were compared to the Eh values computed from each of the individual redox couples ($\text{H}_2\text{O}/\text{O}_2$, $\text{Fe}^{2+}/\text{Fe}^{3+}$, $\text{NH}_4^+/\text{NO}_3^-$, and $\text{H}_2\text{S}/\text{SO}_4$) (Figure 9). The generally poor agreement between measured and computed Eh in groundwater is common and indicates there is no overall system Eh controlling the distribution of all redox-sensitive species. The lack of redox equilibrium has been attributed to a number of factors, such as: (1) non-electroactive behavior at the platinum electrode of some redox couple species, (2) irreversibility or slow kinetics of redox couple reactions, (3) presence of mixed potentials, or (4) Eh measurement errors (Langmuir, 1997). Therefore, Eh should generally be thought of as a qualitative expression of the state of oxidation or reduction in a natural system (Langmuir, 1997). However for LTP tailings, the Eh computed from the $\text{NH}_4^+/\text{NO}_3^-$ redox couple provides the closest match to field-measured Eh values (Figure 9).

2.1.1 Geochemical Modeling of Tailings

The specific form of each dissolved COC in solution is an important factor controlling its ultimate mobility into the alluvial aquifer. The geochemical speciation model PHREEQC (Parkhurst and Appelo, 2013) was used to predict the dissolved forms of U, Se, and Mo in the tailings water. The concentrations of major cations, major anions, metals, and COCs (Attachment 2) were input into the model and the redox was controlled using the $\text{NH}_4^+/\text{NO}_3^-$ redox couple. The MINTEQv4.dat database which was developed by the USEPA was used for all model calculations. The model speciation results for both tailings wells and sumps (Table 4) indicate that the oxidized form of U(VI) predominates and in dissolved form exists primarily as negatively charged carbonate species and/or calcium-magnesium carbonate complexes. Selenium is more easily reduced than uranium, and therefore was predicted to occur mainly as reduced selenite [Se(IV)] (e.g., SeO_3^-) and to a lesser extent oxidized selenate [Se(VI)] (e.g., SeO_4^{2-}). Virtually 100% of the dissolved Mo is predicted to occur as the oxidized molybdate [Mo(VI)] ion (MoO_4^{2-}) (Table 4). The negatively charged species of U, Se, and Mo are collectively referred to as "oxyanions" and generally tend to be relatively mobile in the environment.

The concentrations of COCs in the tailings water are potentially controlled by their occurrence as discrete mineral phases. The potential for a given mineral to exist in contact with the solution can be evaluated using the Saturation Index (SI), which is defined as $\text{SI} = \log (\text{IAP}/K_{\text{sp}})$, where IAP is the ion activity product in solution, and K_{sp} is the solubility product at the field temperature. Thus, when SI

>0 , the IAP exceeds the K_{sp} and the mineral can potentially precipitate (oversaturated). When $SI < 0$, the IAP is less than the K_{sp} and the mineral can dissolve (undersaturated). When $IAP = K_{sp}$, the resulting $SI = 0$ indicates that the mineral and the solution are in equilibrium. Due to inherent uncertainties in the analytical and thermodynamic data, equilibrium conditions are generally assumed to exist when $-0.50 < SI < +0.50$.

The SI values for some of the common uranium, selenium, and molybdenum minerals which control their concentrations in the natural environment are shown in Table 5. The SI values for the reduced uranium(IV) minerals (amorphous UO_2 and crystalline UO_2 , uraninite) are highly undersaturated, in part due to the very low calculated proportion of reduced uranium(IV). In addition, the concentrations of oxidized uranium (VI) and accessory components are not elevated enough to reach saturation with respect to the common oxidized uranium minerals, such as carnotite or tyuyamunite, as indicated by the highly negative SI values in Table 5. Negative SI values for amorphous elemental selenium [Se(am)] and ferroselite ($FeSe_2$, values not shown) indicate that conditions are not adequately reducing to precipitate reduced Se phases. Saturation index values for calcium molybdate ($CaMoO_4$) indicated undersaturated conditions at most locations. Considering some of the potential major mineral phases, the tailings are generally oversaturated or in equilibrium with respect to calcite, ferrihydrite, quartz, and rhodochrosite (Table 5). The tailings are undersaturated with respect to amorphous aluminum hydroxide, and undersaturation was also predicted for the iron sulfides when ferrous iron data were available (not tabulated).

2.2 TAILINGS SOLIDS

The LTP sands were comprised of loose, well-sorted fine sands containing some clay (10 to 20%) and clay stringers. The LTP sands were medium-to dark gray in color, displayed a weak reaction to hydrochloric acid (HCl) indicating the presence of minor carbonate, and moisture content that increased with depth. The LTP slimes consisted of medium-dark gray stiff clays with little sand ($<10\%$). The STP sands consisted of light brown, loose silty sand with traces of clay and strong reaction to HCl. The STP slimes were generally light brown, stiff sandy clays with thin bedding of black and grays. The STP slimes exhibited strong reaction to HCl and often exhibited an odor of sulfur (Attachment 1). Samples of tailings solids from the LTP and STP were subjected to detailed mineralogical and geochemical characterization (Table 1) to understand their bulk mineral composition and reactivity, the forms of COCs present, and the potential for their mobility from tailings upon future weathering.

2.2.1 Tailings Mineralogy

Mineralogical analyses of the LTP and STP tailings solids (Table 1) was conducted by DCM Science Laboratory Inc. located in Wheat Ridge, CO (DCM Science). The detailed XRD mineralogical report from DCM Science is provided in Attachment 3. All samples from the LTP and STP were analyzed using X-ray diffraction (XRD) analyses to identify their bulk and clay mineral compositions. The XRD results in Table 6 show the LTP and STP tailings are composed primarily of quartz, potassium feldspar, and plagioclase feldspar, which generally have low reactivity and are highly resistant to weathering. Lesser amounts of calcite are present which will remain stable in the high pH environment. Relatively low quantities of pyrite (iron sulfide or FeS_2) up to 1% were also identified. Upon exposure to water and atmospheric oxygen, pyrite has the potential to release sulfate and

acidity as it weathers. As expected, the clay content of tailings samples was higher in the slimes compared to the sands, although the maximum measured clay content was only 29%. The tailings clay fractions were dominated by approximate equal amounts of smectite and kaolinite, with lesser amounts of illite and chlorite (Table 6).

Samples from the LTP (WME-2, -3, and -5) and STP (WME-10) were also examined by scanning electron microscopy (SEM) to characterize grain morphology in conjunction with energy dispersive spectroscopy (EDS) to obtain elemental composition. The detailed SEM mineralogical report from DCM Science is provided in Attachment 3 and the key attributes from SEM and EDS examination are summarized in Table 7. Examination of the tailings sands were consistent with XRD results showing that the dominant minerals are quartz, plagioclase feldspar, and K-feldspar. The tailings sands were described as brown in color, containing very fine to medium-grained silty sand with lesser amounts of clay. The feldspar grains commonly display corroded edges and surface pitting, presumably due to the caustic nature of the original milling process solutions. The grey tailings slimes also contained quartz and feldspars as dominant components, with edge corrosion and surface pitting of the feldspars also evident in the slimes.

Some example mineral occurrences observed during SEM examination are shown on Figure 10. Pyrite commonly occurs as mineral inclusions as shown in the grain containing mixed quartz and feldspar (Figure 10a). Rare earth (Ce, La, Nd) phosphate minerals were commonly observed as inclusions within feldspar grains (Figure 10b). Iron exists in both reduced (e.g., pyrite) and oxidized (e.g., goethite) forms, with an example of goethite replacing pyrite on Figure 10c. Calcite is common in both tailings sands and slimes, sometimes with inclusions of Se or gold (Figure 10d). Selenium was the most abundant COC in the tailings and was recognized in association with iron on the surface of pyrite (Figure 11a), as native (elemental) selenium mineral inclusions (Figure 11b) or liberated grains (Figure 11c), and in close association with lead or copper (Figure 11d). Uranium tended to be less abundant during SEM examination but was most commonly observed in association with calcium and vanadium (e.g., tyuyamunite) (Figures 12a, 12b, 12c) or titanium (Figure 12d). No distinct Mo-bearing solids phases could be detected in the tailings using SEM.

2.2.2 Acid-Base Accounting, pH, and Sulfur Forms

Homestake utilized an alkaline leaching process ($\text{pH} > 10$) to recover U from the ore, and the tailings contain acid-consuming silicate minerals and calcite (Section 2.2.1). Therefore the tailings possess some degree of acid neutralization potential (ANP). The original ore and existing tailings also contain minor amounts of iron sulfide minerals (e.g., pyrite) (Section 2.2.1) which can produce acid upon weathering, and thus the tailings also possess some degree of acid generation potential (AGP). Acid generation by tailings is undesirable because acid generation can affect the physical stability of tailings and also accelerate the release of low pH, sulfate, and COCs from tailings upon weathering. The balance between the ANP and the AGP (expressed as $\text{kg CaCO}_3/\text{T}$) is measured using acid-base accounting (ABA), which provides information on forms of sulfur in a sample, particularly acid generating sulfide minerals (e.g., pyrite). The Net Neutralizing Potential (NNP) is calculated as the difference between the ANP and the AGP ($\text{NNP} = \text{ANP} - \text{AGP}$). Theoretically, a given material has an overall capacity to neutralize acidity when $\text{NNP} > 1$, and an overall capacity to generate acidity when

NNP < 1. In practice, it is generally considered that samples containing an NNP > +20 kg CaCO₃/T present the least risk for acid generation (USEPA, 1994).

The ABA results with sulfur forms and calculated NNP values for the tailings are provided in Table 8. The two primary forms of sulfur (S) in the tailings are sulfide-S (reduced) and sulfate-S (oxidized) (Figure 13). The tailings contained up to 0.35% sulfide-S with no distinct differences between sands and slimes. The tailings contain elevated pH (Table 8) and the overall balance between the AGP and ANP is such that the ANP outweighs the AGP (Figure 14) and all NNP values are > +20 kg CaCO₃/T (Table 8). The ABA results indicate that the tailings are theoretically net acid-neutralizing and would not be expected to generate acidity upon weathering, but the tailing have the capacity to release additional sulfate (and potentially COCs) if exposed to atmospheric (oxidizing) conditions.

2.2.3 Cation Exchange Capacity/Total Organic Carbon

The results for cation exchange capacity (CEC) and total organic carbon (TOC) of the tailings are provided in Table 8. The CEC values for the tailings samples are low (3.4 to 14.4 cmol_c/kg) due to the overall low clay content containing approximately 50% kaolinite with low exchange capacity. The TOC content of the tailings ranged from <0.10% in some sands to 0.3% in slimes. The source of TOC in the tailings largely originates from organic material that was present in the original ore. Clays and organic matter may provide a reservoir for solid-phase partitioning of COCs (particularly U and Se) and a source of DOC when present. Although the TOC content is generally low relative to natural soils, its presence has the capability of creating reducing conditions (decreasing Eh) in the tailings water.

2.2.4 Selective Chemical Extraction

A selective chemical extraction technique was used to provide supplemental information regarding the partitioning of COCs within the solid tailings matrix. During selective chemical extraction, a sample of tailings is sequentially leached with a series of increasingly aggressive solutions to extract the COCs from various solid phase components. The selective extraction technique designed by Tessier et al. (1979) targets those mineral phases which have been documented to occur in sandstone and limestone ore (and presumably tailings) from the Grants District: (1) Exchangeable (bound to clay surfaces), (2) carbonate bound (occurring as or coprecipitated with carbonate minerals), (3) oxide bound (adsorbed to or coprecipitated with iron/manganese oxides), (4) organic bound (complexed with organic matter), and (5) residual (occurring as or incorporated within highly-resistant silicate minerals and only dissolved using strong acid). While the original Tessier et al. (2009) procedure did not include a specific step for dissolving reduced sulfide minerals, sulfide minerals would be oxidized and dissolved upon contact with nitric acid. Therefore, Step 4 of the original procedure is referred to as "organic/sulfide bound". The original Tessier et al. (1979) procedure was modified to also extract the water-soluble fraction of COCs prior to the exchangeable phase (Ma and Rao, 1997). The modified selective extraction procedure is shown in Table 9.

It is recognized that no chemical extraction can be 100% selective, however these methods provide a general indication of solid-phase associations and allow for relative comparisons between samples. A few key elements were analyzed in the extracts to qualitatively evaluate the selectiveness of the extraction sequence. Basic plots were then prepared showing the fraction of various extractable forms for tailings and alluvium. For example, calcium is strongly retained by clays and mineralogical testing has indicated the presence of calcite (Table 6). The calcium fractionation results for tailings

(Figure 15) are consistent, indicating that most calcium exists in the exchangeable and carbonate bound form. The low percentage of calcium in the residual fraction (quartz and feldspars) suggests that the form of plagioclase feldspar is low in calcium.

The tailings solutions are elevated in sodium, which is also retained by clays, and consequently fractionation results indicate a large proportion of sodium is soluble and exchangeable. The remaining sodium is associated with the residual fraction, consistent with the presence of a sodium-dominated feldspar rather than a calcium-dominated feldspar (Figure 16). Iron is relatively insoluble and thus the soluble and exchangeable forms should be minor components compared to iron oxides, iron sulfides, or iron carbonate (siderite, which was not identified by XRD or SEM). Fractionation results show little to no occurrence of iron in the soluble, exchangeable, or carbonate bound forms, although iron was extracted from the iron oxide bound, sulfide bound, and residual fractions (Figure 17). The iron fractionation results are consistent with mineralogical identification of iron sulfides (e.g., pyrite), iron oxides (e.g., goethite), resistant iron oxide minerals (e.g., hematite), and aluminosilicate clay minerals which can contain iron. The silica fractionation results (Figure 18) show residual silica is the main component, consistent with a quartz, feldspar, and aluminosilicate clay-dominated mineralogy (Tables 6 and 7). The results for calcium, sodium, iron, and silica (Figures 15 through 18) demonstrate fair selectivity of the chemical extractions, and support the use of selective extractions in evaluating the solid-phase forms of COCs in the tailings.

Uranium was extracted from all fractions but was mainly associated with the soluble and residual fractions (Figure 19). The soluble fraction represents U in tailings pore water and/or dissolution of soluble U minerals (e.g., carnotite, tyuyamunite) which can also be exchanged by clays. The soluble and exchangeable U fractions were higher in slimes compared to sands, presumably due to the relatively higher water and clay content of the slimes. Uranium in the residual form could indicate the presence of coffinite $[\text{U}(\text{SiO}_4)_{1-x}(\text{OH})_{4x}]$, a U-silicate mineral. Uranium can coprecipitate with calcite and therefore may exist as carbonate bound U. Uranium released from the organic/sulfide bound fraction may also indicate the presence of reduced U as uraninite (UO_2). Carnotite, coffinite, and uraninite were known to be present in the sandstone-hosted ore from the Grant District. Mineralogical results were not completely conclusive with respect to the U minerals present and did not identify U in association with silicon. However, U was observed in association with calcium and vanadium, consistent with the presence of carnotite and tyuyamunite, and the observed association of U with titanium and rare earth phosphates may also represent a more resistant (residual) form.

Molybdenum in the tailings tended to be mainly associated with either the soluble or the residual fractions (Figure 20). In the sands, Mo was primarily in the residual phase, whereas a larger proportion of the Mo in the slimes was soluble. The higher fraction of soluble Mo in the slimes is presumably due to their higher porosity and water holding capacity compared to the sands. The organic/sulfide bound fraction was insignificant, suggesting that any molybdenum sulfide that may have been present in the original ore has been oxidized. No discrete Mo-bearing phases were identified during mineralogical analysis, and the form of residual Mo has thus not yet been identified. Selenium in the tailings was predominantly associated with the organic/sulfide bound and soluble fractions (Figure 21). The soluble fraction represents the entrained pore water tailings solution containing elevated Se, while the organic/sulfide bound fraction represents oxidation of reduced iron selenide and native Se that was identified using SEM (Section 2.2.1).

2.2.5 Humidity Cell Testing

Humidity cell tests (HCTs) are designed to accelerate the weathering and release of constituents from a solid by exposing the sample to alternating wetting/drying cycles under oxidizing conditions. The sample is rinsed with clean water on a weekly basis (solution:solid ratio of 1:1) and the leachate is analyzed for the constituents of interest. Results from HCTs can be used to: (1) determine whether a solid material will produce an acidic or alkaline effluent with extensive weathering over time, (2) identify solutes in the effluent that represent dissolved weathering products, such as selenium, uranium, molybdenum, and sulfate that could be released upon oxidation, (3) determine the mass of solute release, and (4) determine the rate at which solutes could be released upon prolonged weathering (ASTM, 2013). The HCTs were conducted on run-of-mine tailings samples, rather than on crushed samples, to avoid any artificial increase in liberation that could result from increased surface area induced by particle size reduction.

Four HCTs were conducted: Two LTP sands (WME-2 and -3), STP sand (WME-9), and STP slime (WME-10) (Table 1). The LTP slime samples contained excessive clay which rendered them unsuitable for testing because water could not easily be passed through and extracted from the material. The HCTs were run for 20 weeks with leachate collected weekly and analyzed for a “short-list” of constituents which includes sulfate, iron, pH, alkalinity, and specific conductivity (SC). A “long-list” of constituents including selected metals (Ca, Mg, Na, Fe, Al, Mn, Si) and COCs (U, V, Mo, Se) was first analyzed weekly (Weeks 0, 1, and 2) and then less frequently (Weeks 4, 6, 8, 10, 12, 16, and 20).

The HCT results for the four samples are summarized on Figures 22 through 25, with detailed results being presented in Attachment 4. The specific conductance (SC) was initially highest for the slime sample, but there was an overall decrease in SC for all samples with time indicating no significant dissolution of soluble or oxidizable minerals (Figure 22). Elevated pH values (>9) in the HCT leachate are consistent with tailings as observed in the initial leachates, but decreased with time as the tailings pore water was rinsed from the solids. The tailings sand pH decreased relatively rapidly compared to the slimes, which are more buffered (Figure 22). However the pH of all HCT effluents remained >7 with no significant effects due to sulfide oxidation. Iron concentrations were low (<1 mg/L) and generally decreased over time, except for a few small concentration spikes which were most pronounced in the slime sample. The iron concentrations in all HCT leachates had decreased to <0.05 mg/L in all samples during the last few weeks of testing, indicating the source of iron (iron sulfides) was exhausted when testing was terminated. The sulfate trends indicate an overall lack of sulfate production from sulfide oxidation (Figure 23).

Uranium, molybdenum, and selenium (Figures 24 and 25) displayed early concentration spikes in a few samples, but the overall decreasing trends do not indicate the presence of significant residual sources of COCs that would be released from the tailings subsequent to future long-term weathering. For the LTP samples, the range of average values during the test was 0.11 to 1.26 mg/L for uranium and 0.087 to 0.28 mg/L for molybdenum. A uranium spike was only observed for the slime sample and is likely due to delayed flushing-diffusion from the finer-grained material (as opposed to oxidation) due to the presence of uranium in the oxidized form. Spikes in molybdenum and selenium were noted in the slime and some sands, and may be the result of either physical (delayed flushing-diffusion) or chemical (oxidation of molybdenum sulfides and elemental selenium).

2.3 TAILINGS CHARACTERIZATION SUMMARY

The LTP pore water contains elevated pH, TDS, and is dominated by sodium, sulfate, and carbonate due to the alkaline milling process. Evaluation of redox conditions indicates the tailings water ranges from oxic to suboxic, with measured Eh values corresponding most closely to those calculated from the $\text{NH}_4^+/\text{NO}_3^-$ redox couple. Water in the tailings sumps tends to be more oxidizing in comparison. Geochemical speciation calculations conducted using the field-derived redox information along with complete water quality analysis indicate that dissolved U and Mo exist primarily in their oxidized forms. The dissolved U primarily occurs as neutral or negatively-charged carbonate species and Mo occurs primarily as the molybdate ion (MoO_4^{2-}). Selenium is more easily reduced and is predicted to exist primarily as reduced [Se(IV)] selenite (SeO_3^{2-}). These forms of COCs are referred to as oxyanions and are relatively mobile in the environment.

The tailings solids are composed primarily of quartz and feldspar, with lesser amounts of clay (smectite, kaolinite), calcite, and minor pyrite (iron sulfide) based on X-ray diffraction (XRD) analysis. The SEM results were consistent with XRD and revealed feldspars with a high degree of edge corrosion and surface pitting due to the caustic environment. Iron was identified as both reduced (pyrite) and oxidized (goethite) minerals. Selenium was the most abundant COC identified using SEM, and was found in a reduced state associated with pyrite and occurring as native Se. Uranium appeared less abundant but was commonly observed in association with calcium and vanadium, suggesting an oxidized form (e.g., tyuyamunite), while no distinct Mo-bearing phases were identified.

Additional geochemical characterization of the tailings solids was conducted using ABA, selective extractions, and humidity cell tests (HCTs). The pyrite content of the tailings (up to 0.35%) contributes to its acid generation capacity, but due a greater potential for acid neutralization, the tailings are net acid neutralizing and thus not expected to become acidic upon future weathering. Selective chemical extraction results showed both U and Mo were predominantly recovered from the soluble (mobile) fraction and an unidentified (immobile) residual fraction. Selenium in the tailings solids was mostly associated with the soluble and organic/sulfide bound fraction, the latter which is consistent with SEM identification of Se occurring with pyrite and as elemental Se. Although there does not appear to be a significant secondary source of U or Mo which could be released during long-term weathering, the existence of reduced forms of Se and iron sulfide could represent a potential future secondary source of Se and sulfate. However, the HCT results collected through 20 weeks of testing did not indicate any significant release of iron, sulfate, uranium, molybdenum, or selenium from the tailings solids.

3.0 ALLUVIAL AQUIFER AND TRANSPORT CHARACTERISTICS

Apart from hydrodynamic factors such as diffusion and dispersion, the mobility of COCs and other mill-derived constituents in the alluvial aquifer will be controlled by the groundwater composition and mineral interactions. Therefore, detailed characterization of water chemistry and aquifer mineralogy was conducted in four general zones to assess the alluvial aquifer with respect to COC transport. The locations for alluvial groundwater sampling includes the two new wells WME-9 and WME-10 completed in alluvium underlying the STP (Figure 2), in addition to the following 13 existing Site monitoring wells categorized with respect to their location relative to the LTP (Table 2 and

Figure 3): (1) North alluvial (background) wells (DD, R, Q), (2) western alluvial wells (S4, M19, MR), (3) southern alluvial wells (D1, X, F, I), and (4) LTP underlying alluvial wells (T2, T20, T22).

3.1 ALLUVIAL WATER QUALITY AND REDOX CONDITIONS

Information regarding detailed water quality and redox conditions in the alluvial groundwater were collected to understand major solution controls on COC transport. All water quality and field parameter results are contained in Attachment 2. The major ion water quality signature for the alluvial wells (Figure 26) shows background wells to the north (Wells DD, R, Q) consist of a Ca-SO₄-type water. Wells to the west tend to be dominated by Na-SO₄-type closest to the LTP due to tailings influence (Well S4) and become more Ca-SO₄ dominated with distance (Wells M19 and MR). Wells to the south (D1, X, F, I) also tend to be more dominated by sodium as the major cation. The alluvial wells underlying the LTP (T2, T20, T22) and the STP (WME-9, WME-10) are consistent with a tailings signature (Figure 4) due to vertical migration of tailings solution into the alluvium, although Well WME-10 appears to be less influenced by tailings.

The pH and TDS for the alluvial wells are shown on Figure 27. The pH values for the alluvial wells are very consistent (within < 1 unit), ranging only from about 6.7 to 7.5 for the wells along flow paths to the west and south. Slightly higher pH values were observed for the background wells to the north and most alluvial wells underlying the LTP and STP. These data indicate that influences of elevated pH in the tailings wells (> 9) (Figure 5) are rapidly attenuated in the alluvial aquifer. Elevated TDS concentrations exist in the alluvial wells underlying the LTP (but not STP) due to ongoing seepage.

The results of field DO measurements using a flow-through cell (Figure 28) indicate most of the alluvial wells studied can be classified as oxic with respect to redox conditions (Table 3), where measurable DO is as high as 6 mg/L in some wells. The alluvial wells underlying the LTP (T2, T20, T22) generally had lower levels of DO while alluvial wells to the south (D1, X, F, I) contained the highest DO concentrations, perhaps due to the injection of fresh water as part of the corrective actions. While the Eh values were highly-variable, higher Eh values (more oxidizing conditions) are also reflected in the wells to the south (Figure 28). The concentrations of ferrous iron (Fe⁺²) were mostly below detection (<0.02 mg/L) with the exception of Well T20 below the LTP where locally-reducing conditions exist and ferrous iron ranged from 2.0 to 5.7 mg/L. The concentrations of H₂S and NH₃-N were below detection or very low in most alluvial wells (Attachment 2).

3.1.1 Geochemical Modeling of Alluvial Aquifer

The specific form of each dissolved COC in solution is an important factor controlling its degree of attenuation in the alluvial aquifer. The geochemical speciation model PHREEQC (Parkhurst and Appelo, 2013) was used to predict the dissolved forms of U, Se, and Mo in the alluvial wells to the north and along potential transport pathways to the west and south. The concentrations of major cations, major anions, metals, and COCs (Attachment 2) were input into the model and the redox was controlled using the O(-2)/O(0) redox couple based on the oxic conditions in the alluvial aquifer where reduced species of nitrogen, iron, and sulfur are very low or non-detectable. The MINTEQA4 database which was developed by the USEPA was used for all model calculations. The model results for the alluvial wells (Table 10) indicates that the oxidized form of U(VI) predominates and exists primarily as the neutral uncharged Ca₂UO₂(CO₃)₃ species and the negatively charged CaUO₂(CO₃)₃²⁻ species. Under oxic conditions, virtually 100% of the selenium is predicted to occur

mainly as selenate [Se(VI)] (e.g., SeO_4^{2-}) and 100% of the dissolved Mo is predicted to occur as the oxidized molybdate ([Mo(VI)] ion (MoO_4^{2-}). The negatively charged species of U, Se, and Mo are collectively referred to as "oxyanions" and generally tend to be relatively mobile in the environment.

The COC concentrations in the alluvial aquifer are potentially controlled by their occurrence as discrete mineral phases and by their interaction with other major minerals along the flow path. The saturation index (SI) values (Section 2.1.1) for some of the common U, Se, and Mo minerals in the natural environment are shown in Table 11. The SI values for the reduced uranium(IV) minerals (amorphous UO_2 and crystalline UO_2 , uraninite) are highly undersaturated, in part due to the very low calculated proportion of reduced uranium(IV). In addition, the concentrations of oxidized uranium(VI) and accessory components are not elevated enough to reach saturation with respect to the oxidized uranium minerals, such as carnotite or tyuyamunite, as indicated by the highly negative SI values. Negative SI values for amorphous elemental selenium [Se(am)] and ferroselite (FeSe_2 , values not shown) indicate conditions are not adequately reducing to precipitate reduced Se phases. Saturation index values for calcium molybdate (CaMoO_4) generally indicate undersaturated conditions, except below the LTP (Wells T2, T20, T22) where the groundwater was either oversaturated or in equilibrium with respect to CaMoO_4 . The alluvial aquifer is in equilibrium with calcite, oversaturated with respect to ferrihydrite and quartz, and undersaturated with respect to aluminum hydroxide. Undersaturation was also predicted for iron sulfide (pyrite), siderite (iron carbonate), and rhodochrosite (manganese carbonate) (data not shown).

3.2 ALLUVIAL AQUIFER SOLIDS

Alluvial aquifer solids were collected for geochemical testing from areas located north (background), south, and adjacent to the LTP, in addition to samples of alluvium that were collected from the perched and underlying vadose zones below the LTP. Table 1 summarizes the original alluvial solids collection and geochemical testing program, and the alluvial boring locations are shown on Figure 3 (it should be noted that saturated alluvium could not be collected from locations WME-12 and WME-13 because the drill stem hit refusal on igneous bedrock before groundwater was encountered). Solid-phase characterization of the aquifer solids is used to develop conceptual potential COC attenuation mechanisms and also provides site-specific input for reactive transport modeling.

3.2.1 Alluvial Aquifer Mineralogy

Mineralogical analyses of the alluvium samples (Table 1) was conducted by DCM Science. The detailed XRD mineralogical report from DCM Science is provided in Attachment 3 and key findings are summarized in Table 7. Seven samples of alluvium were analyzed using X-ray diffraction (XRD) analyses to identify their bulk and clay mineral compositions. The XRD results in Table 6 show the alluvium is primarily composed of quartz, potassium feldspar, plagioclase, and calcite which are very stable but provide little attenuation capacity. Pyrite was detected in the north alluvium sample at the detection limit. The clay content of the alluvium samples ranges from 2 to 15% and is composed of smectite, illite, and kaolinite.

One alluvium sample located directly adjacent to the LTP (WME-16, currently impacted) and a sample from the south (WME-14, formerly impacted) were also examined using SEM to identify potential COC associations and attenuation mechanisms (Table 1, Figure 3). The SEM results were consistent with XRD results indicating that the dominant minerals are quartz, plagioclase feldspar,

and K-feldspar, with lesser amounts of clay. Feldspars were shown to contain small inclusions of pyrite, chalcopyrite, barite, rutile, zircon, and rare earth phosphates. Calcite was the sole carbonate identified with a content ranging from 6 to 20%. The amorphous material in alluvium sample WME-14 which could not be identified using XRD (Table 6) was recognized as volcanic glass using SEM. No Se-, U-, or Mo-bearing phases could be identified.

3.2.2 Acid-Base Accounting, pH, and Sulfur Forms

The ABA results with sulfur forms and calculated NNP values for the alluvium are provided in Table 8. The sulfide-S content in all alluvium samples was below detection (<0.01 %) although traces of pyrite were detected in a few samples during mineralogical testing (Tables 6 and 7). The total-S content of the alluvium is low (<0.01 to 0.04%) and the primary form of sulfur is sulfate-S (likely present as trace gypsum) due to predominantly oxidizing conditions in the alluvium (Figure 13).

3.2.3 Cation Exchange Capacity/Total Organic Carbon

The results for CEC and TOC of the alluvium samples are provided in Table 8. Both CEC values and TOC contents of the alluvium are notably lower compared to the tailings. The CEC of the alluvium (2.9 to 7.7 cmol_c/kg) is low due to the low clay content (Table 6). The TOC content of the alluvium is generally below detection (<0.10%) due to the arid environment and oxidizing conditions.

3.2.4 Selective Chemical Extraction

Chemical selective extraction was also conducted on samples of the alluvium using the procedures outlined in Table 9. The selective extraction results for the alluvium indicate a higher proportion of potentially mobile U phases where the alluvium has been influenced by tailings. Alluvium adjacent to the LTP (WME-16) and from perched and vadose zones underlying the LTP contain higher proportions of soluble, exchangeable, carbonate bound, Fe/Mn oxide bound, and organic/sulfide bound compared to more distant samples (WME-11, -14, and -15) (Figure 29). Similar results were obtained for Mo where the adjacent and underlying alluvium contains an appreciable fraction of soluble Mo compared to the more distant upgradient and downgradient locations (Figure 30). The adjacent and underlying alluvium samples also contained a higher proportion of soluble Se compared to the remaining samples (Figure 31). The perched alluvium sample collected from below the slimes area (WME-8@110) contained a higher proportion of organic/sulfide bound Se compared to the other LTP-influenced samples, potentially indicating the presence of iron selenide and/or native Se under more localized reducing conditions below the LTP.

3.2.5 Meteoric Water Mobility Testing

The Meteoric Water Mobility Procedure (MWMP) is a column percolation test that was originally designed to determine the potential for dissolution and mobility of constituents from mine rock by meteoric water (ASTM, 2002). Although the Synthetic Precipitation Leaching Procedure (SPLP, USEPA Method 1312) outlines similar objectives for fine-grained materials, the MWMP is generally preferred over the SPLP due to the low water:rock ratio used. The MWMP utilizes the lowest water:rock ratio practical for leaching studies (1:1), whereas the SPLP uses a 20:1 water:rock ratio which produces a highly diluted leachate. A consecutive MWMP test consisting of three successive leaches was conducted on the four alluvium samples collected from perched and vadose zones

underlying the LTP (Table 1). The objective of the MWMP testing is to characterize the potential future release of COCs from impacted alluvium underlying the LTP.

The tabulated MWMP results and pore volume (PV) calculations for the alluvium are shown in Table 12. The procedure uses 5 kg of alluvium and a leachate volume of 5 L (1:1) therefore the results can be expressed as either mg/L or mg/kg. The volume of each sample was calculated using a bulk density of 1.86 g/cm³ which was computed assuming a total porosity of 0.30 and a particle density of 2.65 g/cm³. The effective porosity of 0.2 was then used to calculate a PV which is equal to 0.54 L. Therefore, each of the three consecutive 5-L MWMP leaches represents approximately 9 PV (5 L / 0.54).

The MWMP-extractable concentrations of uranium, molybdenum, and selenium are shown relative to their total concentrations on Figures 32 through 34. Except for Mo in the perched zone at location WME-7, the leachable concentrations of COCs are generally higher from samples below the LTP sands compared to samples below the LTP slimes. This is consistent with lower clay contents and soluble COC concentrations observed in the LTP sands indicating a potentially higher degree of COC migration into the alluvium below the sands. The percentages of total U, Mo, and Se leached from the underlying LTP alluvium samples by the MWMP (for Leaches 1 through 3) are indicated on Figures 32 through 34. Only a small fraction of the total was released by the MWMP: 4.9 to 16.3% for uranium, 11.1 to 16.1% for molybdenum, and 1.4 to 15.9% for selenium.

3.3 ALLUVIAL AQUIFER CHARACTERIZATION SUMMARY

The alluvial aquifer quality displayed variable major ion composition depending on proximity to the LTP in the alluvial wells studied. The native alluvial groundwater is a Ca-SO₄ type water, whereas influences from the LTP underlying and adjacent to the LTP is evident by a Na-SO₄ type signature and elevated pH. The alluvial groundwater can be classified as oxic with respect to redox conditions, and is comparatively more oxidizing compared to the LTP pore water. The alluvial solids are predominantly composed of quartz, feldspar, and calcite. Pyrite is generally absent and the alluvium contains low contents of amorphous iron hydroxide and a low clay content. The dissolved U, Mo, and Se exist in their oxidized form as neutral or negatively charged species and therefore would not be expected to be strongly attenuated in the alluvial aquifer.

4.0 LARGE TAILINGS PILE CONCENTRATION REBOUND ASSESSMENT

Active flushing of the LTP ceased entirely in July 2015. The current source control strategy assumes that the majority of uranium in the tailings solids in the LTP is present as soluble uranium in pore water, such that the predicted long-term concentrations will remain stable as the tailings seepage continues to drain. However, in 2010 the U.S. Army Corps of Engineers (ACOE) recognized that a significant mass of uranium is still present in the tailings, and that diffusive mass transfer of soluble uranium from fine-grained materials and/or dissolution of solid-phase uranium could result in additional release of COCs following cessation of flushing. Therefore, based on ACOE recommendations, HMC implemented a tailings rebound study to better support the prediction of long-term post-flushing COC leaching behavior in the LTP.

The initial tailings rebound study (Arcadis, 2012) was conducted in three phases: (1) implementation of a gas tracer study to understand local hydraulic and solute transport properties, (2) direct monitoring of COC trends in the LTP porewater, and (3) laboratory evaluation of COC leaching from tailings solids. It was concluded that significant diffusive mass transfer and subsequent rebound of

COCs is not to be expected following source control at the LTP, and therefore the COC reductions achieved during flushing are likely to be sustained for the long-term. Some uncertainty still exists, however, with respect to this conclusion because: (1) gas tracing does not directly measure COCs, (2) in situ monitoring was limited to a 1-year period from four wells over a small area, (3) no study was conducted to evaluate rebound using isolated tailings samples under controlled conditions, (4) design of the selective dissolution method for tailings did not consider the specific tailings mineralogy, and (5) post-flushing trends of COCs were variable and some concentrations began to increase after flushing ceased. In addition, the ACOE (2010) has expressed concern that the long screen intervals (50 to 80 ft.) complicate the interpretation of water quality trends in the LTP.

The objective of the current rebound study is to conduct additional in situ tailings pore water monitoring from both new (short-screen) and existing (long-screen) wells, evaluate solid-phase forms of COCs, and conduct a controlled column study to improve the assessment of COC rebound in the LTP. The approach for the supplemental tailings rebound assessment is to: (1) Evaluate in detail the long-term pre-and post-flushing trends in COC concentrations in all tailings wells and sumps, (2) extend the in situ post-flush monitoring period for existing wells previously used for that purpose (Arcadis, 2012), (3) expand the areal extent and representativeness of in situ post-flush monitoring by installing additional wells with shorter screen lengths in sands and slimes, and (4) conduct a controlled column study using isolated tailings samples. The evaluation considers the solid-phase chemical and mineralogical information from source characterization and geochemical speciation modeling (Sections 2.0 and 3.0) to understand potential controls on pore water COC concentrations.

4.1 EXISTING AND HISTORICAL MONITORING WELLS (LONG SCREEN)

HMC has routinely used a group of sand and slimes wells installed in the LTP to monitor COC concentrations and to calculate the distribution of soluble uranium in the LTP (HMC and HE, 2019). Hydro-Engineering (Casper, WY) has provided historical tailings water quality data from individual LTP wells, in addition to the volume-weighted average uranium concentrations which have been calculated for uranium (since 2006), molybdenum (since 2010), and selenium (since 2018). Because the number and locations of individual monitoring points varied from year-to-year, the volume-weighted average are used when available to better represent the average concentrations in the LTP.

The long-term average concentrations of U, Mo, and Se in these wells are shown on Figures 35 through 37 compared to times when flushing began in 2000 and when flushing ceased in 2015. Uranium and Mo (Figure 35-36) show similar trends, with average concentrations decreasing sharply upon flushing and an overall downward trend through 2018. The average Se concentrations were more variable but also show an overall decreasing trend since flushing began (Figure 37). Geochemical evaluation of tailings water and solids (Section 2) indicates that U and Mo occur primarily in their dissolved form as mobile oxidized species, whereas Se may occur in solution as both the Se(IV) and Se(VI) oxidation states, and as reduced selenium in association with iron sulfides (pyrite). The higher variability and degree of fluctuation in dissolved Se concentrations compared to U and Mo could be a result of alternating redox conditions induced during flushing. The trends in average COC concentrations since flushing ceased provide no indication of concentration rebound.

4.2 TAILINGS SUMPS

The concentrations of U, Mo, and Se in tailings sumps are also being evaluated as potential indicators of the bulk LTP post-flushing behavior. Uranium concentrations in the sumps have decreased steadily since flushing was initiated and have not demonstrated any significant increasing trends since flushing ceased (Figure 38). Molybdenum concentrations in the sumps also continued to decrease during flushing, and have continued to decrease post-flushing, with the exception of the West 1 Sump, where Mo began to increase after 2017, but has since started to decline (Figure 39). The behavior of Se in most sumps differed from U and Mo, where Se concentrations increased notably in the early years of flushing before rinsing out to levels below pre-flushing concentrations (Figure 40). The increases in Se may have resulted from flushing-enhanced dissolution and/or oxidation of reduced forms of Se which have been identified in the LTP solids (Section 2). The post-flushing trends are mixed, where Se appears to have been increasing in three of the sumps (East 1, East 2, West 1) and decreasing in the remaining three sumps (North 1, North 3, South 1) (Figure 40). Chloride is a conservative constituent which can be used as a baseline to evaluate the potential for diffusive rebound. Chloride concentration trends in sumps (Figure 41) were similar to those of uranium and molybdenum, and the predominantly decreasing trends provide no indication of diffusive rebound.

4.3 EXISTING REBOUND EVALUATION WELLS

Arcadis (2012) used four primary monitoring wells (WF2, WF9, WF11, WE9) for in situ post-flush monitoring of COCs in the LTP. These wells are located in a sub-area of the LTP referred to as the "extended shutdown area" (Figure 1) where flushing ceased on May 19th, 2011. Although this group of wells has extended screen lengths (50 to 80 ft.) as criticized by ACOE (2010), a significant amount of post-flushing data (1-Yr. period) had been collected from these wells. Those post-flushing COC concentrations trends were inconclusive due to the variability in observed post-flushing levels (Arcadis, 2012). Rather than abandon these wells, it was proposed to take advantage of the existing data by re-initiating monitoring on a monthly basis for an additional 1-Yr. period (WME, 2018a).

Uranium concentrations in these wells decreased during active flushing which continued to <1 mg/L during the 1-year monitoring period that followed (Figure 42). Since that time, U concentrations increased to around 1-2 mg/L in three of the wells (WE, WF2, WF9) through 2018, although those concentrations have started to decline. Uranium concentrations have continued to decrease in WF11. Molybdenum concentrations began to increase more rapidly after flushing was ceased compared to U, and have trended upward at these locations except for Well WF11 where Mo has been decreasing (Figure 43). Since flushing ceased, Se concentrations have trended downward in all wells except WF2 where Se has slightly increased (Figure 44). Since flushing ceased, chloride concentrations have increased only slightly in wells WE9, WF2, and WF9, decreased slightly in well WF11 (Figure 45).

In Well WF11, the concentrations of U, Mo, Se, and chloride have all shown decreasing trends since flushing was ceased. At the remaining locations (WE9, WF2, WF9), the increases in U and Mo were also accompanied by an increase in chloride. However there are two locations where Se has decreased (WE9, WF9) while chloride (and U, Mo) have increased. Concentrations which increase in association with chloride are attributed to diffusive rebound, whereas decreasing Se concentrations may be a result of Se reduction and precipitation due to re-establishment of more reducing conditions following flushing.

4.4 NEW TAILINGS WELLS (SHORT SCREEN)

Three new sand wells and three new slime wells with short screen lengths (5') were installed in the LTP to collect tailings solids for geochemical analyses and for monitoring well installation as part of the tailings rebound study (Figure 1, Table 2). The wells are being sampled bi-monthly and analyzed for major cations, anions, trace metals, and COCs (WME, 2018d). Once additional data have been collected from these wells, that information will be incorporated into the final report as part of the rebound assessment.

4.5 CONTROLLED STATIC COLUMN STUDY

On-site static column testing was conducted using tailings collected from the new LTP wells (WME-1 through WME-6) to evaluate potential diffusive rebound of COCs from isolated samples under controlled conditions (WME, 2018d). Minimally-disturbed cores of sand (WME-1 through-3) and slime (WME-4 through 6) were collected during installation of the new wells and placed into six PVC columns (8 in. x 60 in.). Immediately upon filling with tailings, each column was thoroughly flushed with nitrogen gas to minimize contact of the tailings with air and prevent oxidation. Following well development, tailings water from each respective well was placed into a large plastic container and sparged with nitrogen gas. Each column was then filled with their respective tailings water in an up-flow configuration to minimize entrapment of gas within the tailings solids. A sample of the initial column fluid was collected after 24 hours, and then subsequently after 1, 3, 6, 9, and 12 months. Column effluent samples were analyzed for dissolved COCs, major cations/anions, metals, and pH. Detailed column test results are provided in Attachment 5.

The column test results for uranium (Figure 46) and molybdenum (Figure 47) show initial concentration increases in the slimes, but concentrations in all columns either remained constant or decreased slightly during the 1-Year test. Selenium concentrations were most elevated in the initial samples (Day 0), but then rapidly decreased and remained stable during the 1-Year test (Figure 48). The initial selenium concentrations in Columns 1 through 6 were much higher compared to their respective well locations (WME-1 through -6) where water and tailings solids were collected (Attachment 2). Although precautions were taken to exclude atmospheric oxygen from the columns, some oxidation of solid-phase selenium probably occurred during the initial stages of column setup and sampling. Entry of oxygen into the sealed columns was limited however, and reducing conditions were quickly re-established, with associated decreases in selenium. Chloride concentrations (Figure 49) remained constant in all columns and thus provide no indication for diffusive rebound.

4.6 LTP REBOUND EVALUATION SUMMARY

A multi-faceted approach to evaluating post-flushing rebound of COC concentrations in the LTP pore water considers trends in existing tailings wells and sumps, in addition to those being collected from new wells with shorter screens and from a controlled static column study. Although a few select sumps and former rebound monitoring wells have demonstrated increasing COC concentrations since flushing ceased, decreasing trends were observed at the remaining locations. However, the volume-weighted concentrations of uranium, molybdenum, and selenium in the LTP have been decreasing since flushing ceased. In addition, results from the controlled column study provided no indication of diffusive rebound over a 1-Year test period.

5.0 CONCLUSIONS

Geochemical characterization of HMC's LTP facility and the surrounding alluvial aquifer is being conducted to refine and support the current conceptual geochemical model (WME, 2018e), to understand LTP source characteristics, and to predict future COC transport behavior in the alluvial aquifer. Redox conditions in the LTP range from oxic to suboxic such that dissolved selenium is predicted to exist mainly as selenite (SeO_3^-). Molybdenum occurs as the oxidized molybdate ion (MoO_4^{2-}) and uranium as neutral or negatively-charged carbonate complexes. Geochemical testing of the tailings solids indicate they are not net acid generating, and the presence of significant residual secondary sources of uranium or molybdenum were not identified. Yet, some reduced forms of selenium were identified in association with pyrite and occurring as elemental selenium, which could present possible long-term secondary sources of selenium and sulfate. However, the HCT results collected through 20 weeks of testing did not indicate any significant release of iron, sulfate, uranium, molybdenum, or selenium from the tailings solids upon accelerated weathering. Although evaluation of post-flushing rebound in the LTP shows that some wells and sumps have demonstrated COC increases since flushing ceased, their post-flushing volume-weighted concentrations have continued to decrease, and results from the controlled column study provide no indication of diffusive rebound.

The alluvial groundwater can be classified as oxic with respect to redox conditions, and is comparatively more oxidizing compared to the LTP pore water. Aquifer mineralogy results suggest the primary attenuation mechanism for the COCs is adsorption to the surfaces of iron oxide minerals. Because the dissolved uranium, molybdenum, and selenium (primarily as selenate or SeO_4^{2-}) exist in their oxidized form as neutral or negatively charged species, they are not expected to be strongly attenuated in the alluvial aquifer. In the immediate vicinity of the LTP however, molybdenum may be precipitating, where reaction of the LTP pore water with calcite in the alluvium causes oversaturation with respect to calcium molybdate. The information collected to date regarding redox conditions, alluvial aquifer water quality, and mineralogic composition of the aquifer solids are currently being used in development of a reactive transport model for the Site.

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Tables

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Table 1. Summary of Homestake Tailings and Alluvial Solids Sample Collection and Geochemical Testing¹

Location ID	Material Description	Depth (ft. bgs)	ABA-pH- CEC-TOC	XRD	HCT	Selective Extraction	SEM	MWMP
WME-1	LTP Sands	55'	X	X	-----	-----	-----	
WME-2	LTP Sands	61'	X	X	X	X	X	-----
WME-3	LTP Sands	65'	X	X	X	X	X	-----
WME-4	LTP Slimes	65'	X	X	-----	-----	-----	-----
WME-5	LTP Slimes	75'	X	X	-----	X	X	-----
WME-6	LTP Slimes	65'	X	X	-----	X	-----	-----
WME-7@108	LTP Perched Alluvium	108'	X	X	-----	X	-----	X
WME-7@113	LTP Vadose Alluvium	113'	X	X	-----	X	-----	X
WME-8@110	LTP Perched Alluvium	110'	X	X	-----	-----	-----	X
WME-8@121	LTP Vadose Alluvium	121'	X	X	-----	-----	-----	X
WME-9	STP Sands	30'	X	X	X	X	-----	-----
WME-10	STP Slimes	35'	X	X	X	X	X	-----
WME-11	North Alluvium	65'	X	X	-----	X	-----	-----
WME-12	West Alluvium	No Sample	-----	-----	-----	-----	-----	-----
WME-13	West Alluvium	No Sample	-----	-----	-----	-----	-----	-----
WME-14	South Alluvium	45'	X	X	-----	X	X	-----
WME-15	South Alluvium	55'	X	X	-----	-----	-----	-----
WME-16	Adjacent Alluvium	65'	X	X	-----	X	X	-----
WME-17	Adjacent Alluvium	55'	X	X	-----	-----	-----	-----

¹ ABA-pH-CEC-TOC = Acid-base accounting, pH, cation exchange capacity, and total organic carbon. XRD = X-ray Diffraction analysis. HCT = humidity cell testing. SEM = scanning electron microscopy. MWMP = Meteoric Water Mobility Procedure.

Table 2. Well Completion Information and Sampling Protocols for New and Existing Tailings and Alluvial Wells¹

Well ID	Lithology	Total Depth (ft. TOC)	Top Screen (ft. TOC)	Depth to Water (ft. TOC)	Saturated Thickness (ft.)	Well Volume (gal.)	Sampling Frequency & Duration ²
WME-1	LTP Sands	57.30	51.80	53.45	3.85	2.5	2 months / 2 years
WME-2	LTP Sands	64.60	59.10	57.25	7.35	4.8	
WME-3	LTP Sands	72.65	67.15	61.3	11.35	7.4	
WME-4	LTP Slimes	67.60	62.10	57.49	10.11	6.6	
WME-5	LTP Slimes	77.32	71.82	66.98	10.34	6.8	
WME-6	LTP Slimes	67.25	61.75	54.95	12.30	8.0	
WF2	LTP Slimes	110	28	62.33	47.67	48.6	1 month / 1 year
WF9	LTP Slimes	116	36	63.65	52.35	53.4	
WF11	LTP Slimes	116	36	56.52	60.42	61.6	
WE9	LTP Slimes	116	36	55.58	60.20	61.4	
WME-9	STP Alluvium	73.20	67.70	58.5	14.70	9.6	Quarterly / 2 years
WME-10	STP Alluvium	76.70	71.20	58.9	17.80	11.6	
DD	North Alluvial	79.8	40.0	47.9	32.0	21.0	Quarterly / 1 year
R		85.0	60.0	39.84	45.16	29.3	
Q		102.17	72.0	42.08	60.1	39.1	
S4	Western Alluvial	112.05	50.0	39.7	72.4	47.0	
M19		104.1	60.0	65.5	38.6	25.3	
MR		75.85	54.0	66.46	9.39	9.5	
D1	Southern Alluvial	87.0	58.0	40.5	46.5	47.4	
X		48.6	-----	31.50	17.1	11.1	
F		62.0	50.0	34.1	27.9	18.2	
I		69.4	52.0	36.2	33.2	21.5	
T2	LTP Underlying Alluvial	186.0	100.0	119.8	66.2	67.5	
T20		157.3	140.0	129.5	27.8	28.4	
T22		159.0	120.0	122.9	36.1	36.8	

¹ Water levels and volumes based on measurements from June 2018. ² Analyses include major cations (Ca, Mg, Na, K), Major anions (Cl, SO₄, NO₃+NO₂-N, NH₃-N, PO₄, F, HCO₃+CO₃), metals (Al, Fe, Mn, Si), COCs (U, V, Mo, Se), field redox parameters (DO, pH, ORP/Eh, specific conductivity temperature, ferrous iron, sulfide-S using a flow cell.

Table 3. Redox Classification for Groundwater Showing Concentrations of Dissolved Oxygen, Total, Sulfide, and Characteristic Mineral Phases

Environment	Characteristic Mineral Phases
Oxic - $O_2 > 1 \text{ mg/L}$	Iron oxides (hematite, ferrihydrite), manganese oxides, organic matter absent
Suboxic - $O_2 \geq 0.03 \text{ mg/L}$ and $< 1 \text{ mg/L}$; detectable Mn	Iron oxides (hematite, ferrihydrite), manganese oxides, minor organic matter
Anoxic ($O_2 < 0.03 \text{ mg/L}$)	Pyrite/marcasite, rhodochrosite, organic matter
Sulfidic ($H_2S \geq 0.03 \text{ mg/L}$)	
Nonsulfidic ($H_2S < 0.03 \text{ mg/L}$)	

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Table 4. Percent Distribution of Species for Uranium, Selenium, and Molybdenum for LTP Wells and Sumps¹

Location	Date	Uranium					Selenium			Molybdenum
		$\text{UO}_2(\text{CO}_3)_3^{4-}$	$\text{CaUO}_2(\text{CO}_3)_3^{2-}$	$\text{Ca}_2\text{UO}_2(\text{CO}_3)_3$	$\text{MgUO}_2(\text{CO}_3)_3^{2-}$	$\text{UO}_2(\text{CO}_3)_2^{2-}$	SeO_3^{2-}	HSeO_3^-	SeO_4^{2-}	MoO_4^{2-}
WME-1	8/21/2018	99.98	0.02	0.00	0.00	0.00	96.16	0.27	3.57	100
WME-1	10/25/2018	99.99	0.01	0.00	0.00	0.00	98.38	0.37	1.25	100
WME-1	12/14/2018	99.94	0.06	0.00	0.00	0.00	98.97	0.44	0.59	100
WME-2	8/21/2018	90.38	9.22	0.32	0.05	0.03	95.23	4.18	0.59	100
WME-2	10/25/2018	92.67	7.05	0.22	0.04	0.01	96.75	1.66	1.60	100
WME-2	12/14/2018	89.77	9.81	0.38	0.02	0.01	96.50	1.44	2.06	100
WME-3	8/21/2018	97.86	2.11	0.02	0.01	0.01	93.83	1.35	4.82	100
WME-3	10/25/2018	98.80	1.18	0.01	0.01	0.01	80.94	0.58	18.49	100
WME-3	12/14/2018	96.23	3.70	0.05	0.01	0.01	83.27	0.44	16.29	100
WME-4	8/21/2018	99.99	0.01	0.00	0.00	0.00	92.22	0.15	7.64	100
WME-4	10/25/2018	100.00	0.00	0.00	0.00	0.00	93.87	0.09	6.03	100
WME-4	12/14/2018	99.99	0.01	0.00	0.00	0.00	98.56	0.21	1.22	100
WME-5	8/22/2018	99.78	0.22	0.00	0.00	0.00	4.12	0.00	95.88	100
WME-5	10/25/2018	99.89	0.11	0.00	0.00	0.00	11.54	0.00	88.46	100
WME-5	12/14/2018	99.71	0.28	0.00	0.00	0.00	28.85	0.02	71.13	100
WME-6	8/22/2018	99.89	0.11	0.00	0.00	0.00	89.03	0.37	10.60	100
WME-6	10/25/2018	99.91	0.09	0.00	0.00	0.00	73.21	0.16	26.63	100
WME-6	12/14/2018	99.42	0.57	0.01	0.00	0.00	82.68	0.19	17.14	100
WE9	4/16/2018	84.38	14.70	0.72	0.19	0.02	80.35	0.49	19.15	100
WE9	5/23/2018	79.43	19.11	1.20	0.22	0.04	94.92	4.71	0.37	100
WE9	6/6/2018	82.01	16.80	0.99	0.17	0.03	96.09	3.17	0.75	100
WE9	8/13/2018	91.34	8.25	0.21	0.18	0.02	94.66	1.71	3.63	100
WE9	10/2/2018	88.12	11.26	0.44	0.16	0.02	95.50	1.65	2.85	100
WE9	10/30/2018	88.47	10.86	0.49	0.16	0.02	96.49	1.86	1.65	100
WE9	11/27/2018	86.80	12.50	0.56	0.13	0.02	94.94	1.29	3.77	100
WE9	12/18/2018	89.76	9.78	0.36	0.09	0.01	93.90	0.97	5.13	100
WF2	4/11/2018	93.73	5.99	0.16	0.10	0.01	96.39	1.63	1.98	100
WF2	5/23/2018	95.84	3.99	0.13	0.05	0.01	96.27	1.28	2.45	100

Table 4. Percent Distribution of Species for Uranium, Selenium, and Molybdenum for LTP Wells and Sumps (Continued)

Location	Date	Uranium					Selenium			Molybdenum
		$\text{UO}_2(\text{CO}_3)_3^{4-}$	$\text{CaUO}_2(\text{CO}_3)_3^{2-}$	$\text{Ca}_2\text{UO}_2(\text{CO}_3)_3$	$\text{MgUO}_2(\text{CO}_3)_3^{2-}$	$\text{UO}_2(\text{CO}_3)_2^{2-}$	SeO_3^{2-}	HSeO_3^-	SeO_4^{2-}	MoO_4^{2-}
WF2	6/6/2018	93.92	5.82	0.16	0.09	0.01	89.78	1.12	9.10	100
WF2	8/13/2018	94.36	5.39	0.11	0.12	0.01	92.15	1.01	6.84	100
WF2	10/2/2018	95.88	3.94	0.08	0.09	0.01	87.06	0.54	12.41	100
WF2	10/30/2018	94.71	5.03	0.14	0.10	0.01	92.83	0.80	6.37	100
WF2	11/26/2018	93.10	6.60	0.20	0.10	0.01	89.90	0.57	9.53	100
WF2	12/18/2018	94.29	5.46	0.16	0.08	0.01	88.01	0.51	11.48	100
WF9	4/10/2018	89.70	9.74	0.38	0.16	0.02	96.59	2.31	1.10	100
WF9	5/7/2018	84.28	14.68	0.83	0.18	0.02	95.71	2.05	2.23	100
WF9	6/6/2018	80.49	17.94	1.37	0.19	0.02	96.05	2.06	1.89	100
WF9	7/18/2018	80.51	18.17	1.09	0.21	0.02	92.17	1.81	6.02	100
WF9	8/16/2018	84.43	14.55	0.84	0.16	0.02	95.81	1.74	2.45	100
WF9	10/2/2018	87.93	11.38	0.55	0.12	0.01	94.58	1.01	4.41	100
WF9	10/30/2018	86.88	12.24	0.72	0.15	0.01	94.45	0.94	4.61	100
WF9	11/26/2018	81.55	17.01	1.30	0.13	0.01	92.65	0.85	6.51	100
WF9	12/17/2018	86.94	12.29	0.64	0.12	0.01	91.95	0.72	7.33	100
WF11	4/5/2018	66.65	30.11	2.91	0.29	0.05	94.49	5.15	0.36	100
WF11	5/23/2018	60.76	34.76	4.15	0.28	0.04	94.81	4.87	0.31	100
WF11	6/5/2018	45.82	45.79	8.10	0.23	0.06	92.42	7.36	0.22	100
WF11	7/18/2018	53.76	40.25	5.66	0.26	0.07	90.84	9.04	0.12	100
WF11	8/16/2018	69.13	28.14	2.42	0.26	0.04	95.47	3.87	0.66	100
WF11	10/1/2018	49.06	43.89	6.74	0.25	0.06	93.36	6.21	0.43	100
WF11	10/30/2018	49.33	42.25	8.13	0.25	0.05	92.70	7.15	0.15	100
WF11	11/26/2018	36.98	50.01	12.75	0.24	0.02	95.87	2.78	1.34	100
WF11	12/17/2018	39.69	47.81	12.27	0.21	0.02	95.99	3.59	0.42	100
East 1 Sump	3/20/2018	99.98	0.02	0.00	0.00	0.00	98.39	0.32	1.29	100
East 1 Sump	5/7/2018	99.98	0.02	0.00	0.00	0.00	97.91	0.44	1.65	100
East 1 Sump	7/17/2018	99.97	0.02	0.00	0.00	0.00	96.55	0.53	2.92	100
East 1 Sump	9/11/2018	99.98	0.02	0.00	0.00	0.00	91.81	0.61	7.59	100

Table 4. Percent Distribution of Species for Uranium, Selenium, and Molybdenum for LTP Wells and Sumps (Continued)

Location	Date	Uranium					Selenium			Molybdenum
		$\text{UO}_2(\text{CO}_3)_3^{4-}$	$\text{CaUO}_2(\text{CO}_3)_3^{2-}$	$\text{Ca}_2\text{UO}_2(\text{CO}_3)_3$	$\text{MgUO}_2(\text{CO}_3)_3^{2-}$	$\text{UO}_2(\text{CO}_3)_2^{2-}$	SeO_3^{2-}	HSeO_3^-	SeO_4^{2-}	MoO_4^{2-}
East 2 Sump	3/20/2018	99.94	0.06	0.00	0.00	0.00	97.23	0.34	2.43	100
East 2 Sump	5/7/2018	99.92	0.08	0.00	0.00	0.00	97.20	0.57	2.23	100
East 2 Sump	7/17/2018	99.96	0.04	0.00	0.00	0.00	96.41	0.54	3.05	100
East 2 Sump	9/11/2018	99.93	0.06	0.00	0.00	0.00	91.14	0.64	8.21	100
North 1 Sump	3/20/2018	99.87	0.12	0.00	0.00	0.00	98.49	0.62	0.89	100
North 1 Sump	5/2/2018	99.81	0.18	0.00	0.00	0.00	98.55	0.78	0.66	100
North 1 Sump	7/16/2018	99.85	0.14	0.00	0.00	0.00	97.98	0.89	1.14	100
North 1 Sump	9/10/2018	99.89	0.11	0.00	0.00	0.00	91.18	0.97	7.85	100
North 3 Sump	3/20/2018	99.84	0.16	0.00	0.00	0.00	99.09	0.69	0.22	100
North 3 Sump	5/3/2018	98.88	1.06	0.05	0.01	0.00	94.30	5.69	0.01	100
North 3 Sump	7/16/2018	99.86	0.14	0.00	0.00	0.00	94.76	0.96	4.28	100
North 3 Sump	9/11/2018	99.94	0.06	0.00	0.00	0.00	97.82	0.94	1.24	100
South 1 Sump	3/20/2018	77.84	18.40	3.58	0.16	0.03	86.80	13.19	0.01	100
South 1 Sump	5/3/2018	75.90	20.09	3.83	0.15	0.04	85.17	14.82	0.01	100
South 1 Sump	7/16/2018	73.77	22.86	3.09	0.21	0.08	82.28	17.67	0.05	100
South 1 Sump	9/11/2018	74.45	22.09	3.23	0.19	0.03	92.09	7.62	0.29	100
West 1 Sump	3/20/2018	99.81	0.19	0.00	0.00	0.00	99.23	0.60	0.18	100
West 1 Sump	5/2/2018	99.81	0.19	0.00	0.00	0.00	98.70	0.91	0.39	100
West 1 Sump	7/16/2018	98.57	1.37	0.04	0.01	0.00	95.97	1.92	2.11	100
West 1 Sump	9/11/2018	99.95	0.05	0.00	0.00	0.00	98.08	1.08	0.84	100

¹ Percent distribution for a given species is calculated as (species molality/total molality) *100.

Table 5. Saturation Index (SI) Values for Various Uranium, Selenium, and Molybdenum Minerals for the LTP

Location	Date	Calcite CaCO ₃	Amorphous Aluminum Hydroxide Al(OH) ₃ (am)	Ferrihydrite Fe(OH) ₃ (am)	Quartz SiO ₂	Amorphous Uranium Oxide UO ₂ (am)	Uraninite UO ₂ (c)	Tyuyamunite Ca(UO ₂)(VO ₄) ₂ · (5-8)H ₂ O	Carnotite K ₂ O·2UO ₃ ·V ₂ O ₅	Uranium Phosphate (UO ₂) ₃ (PO ₄) ₂	Native Selenium Se(am)	Calcium Molybdate CaMoO ₄	Rhodochrosite MnCO ₃
WME-1	8/21/2018	1.07	-2.69	2.85	0.09	-22.9	-17.14	-18.96	-8.47	-22.84	-23.34	-0.83	0.95
WME-1	10/25/2018	0.65	-2.25	2.96	0.08	-22.7	-16.93	-18.31	-7.92	-23.07	-22.65	-1.25	1.14
WME-1	12/14/2018	1.31	-3.27	1.54	0.28	-22.6	-16.77	-18.74	-8.46	-22.43	-22.42	-0.56	-0.58
WME-2	8/21/2018	0.73	-2.41	3.13	0.20	-19.9	-14.18	-13.48	-6.38	-18.35	-19.54	-1.25	0.54
WME-2	10/25/2018	0.89	-2.72	2.57	0.04	-20.5	-14.69	-13.69	-6.28	-18.77	-21.42	-1.21	0.82
WME-2	12/14/2018	1.01	-3.47	1.78	0.07	-20.5	-14.74	-15.53	-7.40	-18.97	-22.39	-1.25	0.67
WME-3	8/21/2018	0.67	-3.20	2.86	-0.07	-21.0	-15.28	-15.95	-7.04	-19.53	-22.26	-1.95	0.29
WME-3	10/25/2018	0.49	-3.21	2.40	-0.35	-21.2	-15.54	-14.87	-6.60	-19.06	-23.66	-2.21	0.93
WME-3	12/14/2018	0.90	-3.70	1.73	-0.38	-21.0	-15.27	-14.68	-6.69	-18.73	-24.81	-1.76	0.24
WME-4	8/21/2018	1.65	-3.51	2.43	-0.08	-24.4	-18.66	-21.27	-9.56	-24.26	-24.35	-0.22	0.12
WME-4	10/25/2018	1.15	-2.40	2.84	-0.15	-24.2	-18.46	-20.21	-8.71	-24.27	-25.14	-0.67	1.72
WME-4	12/14/2018	1.96	-3.51	1.85	0.05	-24.1	-18.35	-24.19	-11.11	-24.01	-23.30	0.17	0.29
WME-5	8/22/2018	0.72	-3.68	0.32	-0.55	-22.1	-16.31	-11.85	-4.30	-19.14	-31.16	-1.48	0.01
WME-5	10/25/2018	0.73	-3.52	1.55	-0.34	-22.1	-16.37	-11.94	-4.24	-18.99	-30.08	-1.25	1.25
WME-5	12/14/2018	1.21	-4.55	0.69	-0.28	-22.3	-16.48	-13.22	-5.27	-19.27	-29.11	-0.86	-0.06
WME-6	8/22/2018	0.48	-3.82	1.17	-0.10	-22.0	-16.28	-18.79	-8.07	-21.28	-24.59	-1.87	0.13
WME-6	10/25/2018	0.49	-3.08	2.34	-0.26	-22.0	-16.29	-16.00	-6.62	-20.49	-25.50	-1.72	1.28
WME-6	12/14/2018	1.27	-3.85	1.09	-0.24	-22.2	-16.37	-17.78	-7.95	-20.52	-25.83	-1.09	0.15
WE9	4/16/2018	1.18	-4.85	1.49	-0.27	-20.3	-14.61	-12.27	-5.79	-17.36	-24.34	-1.26	-0.61
WE9	5/23/2018	0.90	-3.17	2.45	0.25	-19.3	-13.58	-12.98	-6.20	-17.55	-18.97	-1.14	-0.98
WE9	6/6/2018	1.00	-4.21	2.19	0.19	-19.8	-14.02	-13.82	-6.60	-17.46	-20.06	-1.13	-0.86
WE9	8/13/2018	0.82	-4.28	1.72	-0.01	-20.2	-14.52	-13.13	-6.12	-18.09	-21.00	-1.48	-0.85
WE9	10/2/2018	0.96	-4.62	1.43	0.07	-20.0	-14.27	-13.57	-6.41	-17.55	-21.09	-1.30	-0.79
WE9	10/30/2018	1.02	-2.89	3.03	0.12	-19.9	-14.17	-13.02	-6.00	-16.91	-20.76	-1.08	0.23
WE9	11/27/2018	1.09	-3.70	1.51	0.00	-20.3	-14.51	-13.90	-6.58	-18.37	-21.76	-1.25	-1.18
WE9	12/18/2018	1.06	-3.79	1.13	-0.05	-20.5	-14.72	-14.32	-6.80	-18.55	-22.83	-1.33	-0.14
WF2	4/11/2018	0.95	-4.27	1.63	0.05	-20.3	-14.53	-13.53	-6.30	-18.26	-20.57	-1.17	-0.67
WF2	5/23/2018	1.10	-3.64	1.90	0.00	-20.6	-14.89	-15.11	-7.10	-18.69	-21.39	-1.00	-0.69
WF2	6/6/2018	1.06	-3.84	2.03	-0.04	-20.6	-14.98	-14.48	-6.90	-18.34	-21.85	-1.12	-0.33
WF2	8/13/2018	0.89	-4.82	1.20	-0.09	-20.5	-14.78	-14.44	-6.73	-18.03	-21.89	-1.39	-0.82
WME-1	8/21/2018	0.93	-4.88	1.18	-0.20	-20.7	-14.92	-14.78	-6.79	-18.31	-24.12	-1.34	-0.70
WME-1	10/25/2018	1.07	-2.69	2.85	0.09	-22.9	-17.14	-18.96	-8.47	-22.84	-23.34	-0.83	0.95
WME-1	12/14/2018	0.65	-2.25	2.96	0.08	-22.7	-16.93	-18.31	-7.92	-23.07	-22.65	-1.25	1.14
WME-2	8/21/2018	1.31	-3.27	1.54	0.28	-22.6	-16.77	-18.74	-8.46	-22.43	-22.42	-0.56	-0.58
WME-2	10/25/2018	0.73	-2.41	3.13	0.20	-19.9	-14.18	-13.48	-6.38	-18.35	-19.54	-1.25	0.54
WME-2	12/14/2018	0.89	-2.72	2.57	0.04	-20.5	-14.6	-13.69	-6.28	-18.77	-21.42	-1.21	0.82
WME-3	8/21/2018	1.01	-3.47	1.78	0.07	-20.5	-14.7	-15.53	-7.40	-18.97	-22.39	-1.25	0.67

Table 5. Saturation Index (SI) Values for Various Uranium, Selenium, and Molybdenum Minerals for the LTP (Continued)

Location	Date	Calcite CaCO ₃	Amorphous Aluminum Hydroxide Al(OH) ₃ (am)	Ferrihydrite Fe(OH) ₃ (am)	Quartz SiO ₂	Amorphous Uranium Oxide UO ₂ (am)	Uraninite UO ₂ (c)	Tyuyamunite Ca(UO ₂)(VO ₄) ₂ · (5-8)H ₂ O	Carnotite K ₂ O·2UO ₃ ·V ₂ O ₅	Uranium Phosphate (UO ₂) ₃ (PO ₄) ₂	Native Selenium Se(am)	Calcium Molybdate CaMoO ₄	Rhodochrosite MnCO ₃
WF2	10/2/2018	0.93	-4.88	1.18	-0.20	-20.72	-14.92	-14.78	-6.79	-18.31	-24.12	-1.34	-0.70
WF2	10/30/2018	1.03	-3.32	2.06	-0.11	-20.48	-14.68	-13.68	-6.24	-17.09	-22.24	-1.02	0.37
WF2	11/26/2018	1.12	-4.13	1.13	-0.20	-20.72	-14.90	-14.52	-6.78	-18.14	-23.26	-1.19	-0.52
WF2	12/18/2018	1.12	-4.00	0.98	-0.18	-20.84	-15.02	-15.55	-7.30	-18.42	-23.73	-1.18	-0.68
WF9	4/10/2018	0.90	-4.07	1.29	0.00	-19.61	-13.81	-11.46	-5.33	-17.05	-20.70	-1.17	-0.36
WF9	5/7/2018	1.12	-4.03	2.79	0.01	-19.72	-13.96	-11.31	-5.39	-16.89	-20.89	-1.02	-0.30
WF9	6/6/2018	1.23	-4.30	1.94	0.02	-19.83	-14.06	-11.49	-5.53	-17.06	-20.72	-0.91	-0.19
WF9	7/18/2018	1.20	-4.45	1.67	-0.07	-19.92	-14.23	-11.05	-5.43	-17.05	-21.14	-1.06	-0.26
WF9	8/16/2018	1.14	-4.75	1.37	-0.11	-19.90	-14.12	-11.37	-5.47	-17.31	-21.53	-1.06	-0.15
WF9	10/2/2018	1.13	-4.54	1.16	-0.22	-20.03	-14.22	-11.37	-5.32	-17.24	-22.98	-1.10	-0.21
WF9	10/30/2018	1.23	-3.25	2.05	-0.15	-20.07	-14.26	-11.12	-5.17	-16.60	-22.61	-0.92	0.32
WF9	11/26/2018	1.38	-3.71	1.33	-0.13	-20.37	-14.56	-12.61	-6.04	-17.63	-22.58	-0.91	-0.03
WF9	12/17/2018	1.23	-3.88	1.83	-0.24	-20.32	-14.51	-11.91	-5.67	-17.59	-23.43	-1.09	-0.31
WF11	4/5/2018	1.00	-3.15	2.62	0.28	-19.34	-13.56	-11.26	-5.42	-17.36	-19.02	-1.15	-0.12
WF11	5/23/2018	1.10	-3.14	2.30	0.31	-19.47	-13.67	-13.07	-6.27	-17.56	-19.23	-1.09	-0.08
WF11	6/5/2018	1.08	-3.03	2.41	0.32	-19.19	-13.43	-12.90	-6.46	-16.78	-17.60	-1.07	0.10
WF11	7/18/2018	0.92	-4.16	2.17	0.27	-18.90	-13.13	-13.15	-6.53	-17.13	-17.57	-1.18	-0.09
WF11	8/16/2018	1.01	-4.04	1.94	0.19	-19.69	-13.91	-13.72	-6.71	-17.84	-19.44	-1.28	0.00
WF11	10/1/2018	1.08	-4.14	2.12	0.20	-19.33	-13.59	-12.32	-6.09	-16.87	-18.32	-1.11	0.06
WF11	10/30/2018	1.10	-2.46	3.16	0.32	-19.07	-13.28	-11.62	-5.65	-15.52	-18.07	-0.89	0.10
WF11	11/26/2018	1.49	-4.43	1.46	0.19	-20.08	-14.30	-13.10	-6.54	-19.17	-20.57	-0.90	0.74
WF11	12/17/2018	1.42	-3.23	2.10	0.28	-19.91	-14.07	-13.30	-6.58	-19.20	-20.01	-0.93	0.64
East 1 Sump	3/20/2018	0.71	-4.07	1.49	-0.25	-22.56	-16.67	-18.59	-7.89	-23.04	-23.04	-1.23	0.22
East 1 Sump	5/7/2018	0.73	-3.95	1.73	-0.16	-22.65	-16.83	-18.57	-7.96	-23.05	-22.06	-1.18	0.67
East 1 Sump	7/17/2018	0.72	-3.70	2.23	-0.24	-22.59	-16.84	-18.15	-7.79	-22.80	-21.84	-1.24	0.64
East 1 Sump	9/11/2018	0.42	-4.17	1.59	-0.30	-22.62	-16.97	-19.06	-8.26	-22.89	-21.05	-1.62	0.01
East 2 Sump	3/20/2018	0.99	-3.65	1.57	-0.11	-22.32	-16.47	-19.33	-8.54	-22.20	-22.95	-1.00	0.15
East 2 Sump	5/7/2018	1.00	-3.55	2.34	-0.04	-22.45	-16.66	-19.60	-8.79	-22.22	-21.43	-1.10	0.25
East 2 Sump	7/17/2018	0.69	-3.52	2.07	-0.07	-22.30	-16.54	-18.85	-8.25	-22.13	-21.54	-1.31	0.26
East 2 Sump	9/11/2018	0.87	-3.80	2.48	-0.08	-22.44	-16.79	-19.07	-8.60	-21.99	-20.90	-1.19	0.63

Table 5. Saturation Index (SI) Values for Various Uranium, Selenium, and Molybdenum Minerals for the LTP (Continued)

Location	Date	Calcite CaCO ₃	Amorphous Aluminum Hydroxide Al(OH) ₃ (am)	Ferrihydrite Fe(OH) ₃ (am)	Quartz SiO ₂	Amorphous Uranium Oxide UO ₂ (am)	Uraninite UO ₂ (c)	Tyuyamunite Ca(UO ₂)(VO ₄) ₂ · (5-8)H ₂ O	Carnotite K ₂ O·2UO ₃ ·V ₂ O ₅	Uranium Phosphate (UO ₂) ₃ (PO ₄) ₂	Native Selenium Se(am)	Calcium Molybdate CaMoO ₄	Rhodochrosite MnCO ₃
North 1 Sump	3/20/2018	0.91	-3.63	1.81	-0.07	-21.50	-15.63	-16.79	-7.34	-21.31	-21.39	-0.95	0.22
North 1 Sump	5/2/2018	1.08	-3.19	2.42	0.02	-21.56	-15.71	-17.12	-7.71	-20.64	-20.77	-0.76	0.21
North 1 Sump	7/16/2018	1.00	-3.39	2.29	-0.06	-21.60	-15.82	-16.80	-7.51	-20.68	-20.43	-0.85	0.21
North 1 Sump	9/10/2018	0.92	-3.85	2.55	-0.26	-21.98	-16.39	-16.79	-7.64	-21.04	-20.38	-0.98	0.40
North 3 Sump	3/20/2018	0.95	-3.43	1.60	0.04	-21.27	-15.30	-17.09	-7.47	-21.06	-21.50	-0.81	0.21
North 3 Sump	5/3/2018	0.78	-2.48	3.10	0.22	-19.44	-13.56	-15.04	-6.88	-17.56	-16.90	-0.63	-0.24
North 3 Sump	7/16/2018	0.91	-3.34	2.67	-0.15	-21.65	-15.99	-16.36	-7.39	-20.51	-20.23	-0.97	0.24
North 3 Sump	9/11/2018	0.99	-3.39	2.56	-0.07	-22.12	-16.40	-17.13	-7.77	-21.47	-20.14	-0.85	0.70
South 1 Sump	3/20/2018	1.02	-2.53	3.59	0.48	-17.64	-11.83	-10.73	-4.99	-16.08	-15.79	-0.16	0.42
South 1 Sump	5/3/2018	0.99	-2.69	3.47	0.44	-17.60	-11.81	-10.56	-5.02	-14.75	-14.63	-0.17	0.32
South 1 Sump	7/16/2018	0.83	-1.73	3.96	0.24	-17.36	-11.71	-8.95	-4.34	-13.50	-14.25	-0.32	0.99
South 1 Sump	9/11/2018	1.20	-4.06	3.13	0.25	-18.45	-12.77	-10.87	-5.22	-14.92	-16.77	-0.30	0.51
West 1 Sump	3/20/2018	1.17	-1.65	2.74	0.35	-21.40	-15.40	-16.85	-7.38	-21.11	-22.11	-0.63	1.16
West 1 Sump	5/2/2018	1.11	-2.83	2.23	-0.06	-21.51	-15.65	-16.94	-7.58	-20.67	-20.57	-0.67	0.20
West 1 Sump	7/16/2018	1.26	-2.53	3.48	0.09	-20.79	-15.13	-14.53	-6.76	-18.54	-18.94	-0.54	0.59
West 1 Sump	9/11/2018	0.88	-3.41	2.55	-0.10	-22.10	-16.37	-17.67	-7.92	-21.67	-19.75	-0.92	0.47

Table 6. Semi-Quantitative X-ray Diffraction Mineralogy Results (% by Weight) for Homestake Tailings and Alluvium Samples

Sample ID	Sample Type	Quartz	Potassium Feldspar	Plagioclase	Calcite	Pyrite	Smectite	Illite	Kaolinite	Chlorite	Total Clay
----- % -----											
WME-1	LTP Sands	47	15	15	10	1	5	<1	6	1	12
WME-2	LTP Sands	55	14	14	8	1	3	<1	4	1	8
WME-3	LTP Sands	59	11	12	8	1	2	1	4	1	9
WME-4	LTP Slimes	46	13	14	8	1	6	1	9	2	18
WME-5	LTP Slimes	45	12	12	8	1	9	2	10	2	23
WME-6	LTP Slimes	37	9	12	13	<1	13	2	11	3	29
WME-9	STP Sands	69	11	10	2	<1	3	2	3	<1	8
WME-10	STP Slimes	53	14	14	9	<1	4	1	3	2	10
WME-8@ 110	LTP Perched Alluvium	72	10	7	4	<1	4	1	2	<1	7
WME-8@121	LTP Vadose Alluvium	74	8	7	6	<1	3	1	1	<1	5
WME-11	North Alluvium	73	7	7	9	1	1	1	1	<1	3
WME-14 ¹	South Alluvium	40	5	6	21	<1	4	6	5	<1	15
WME-15	South Alluvium	72	7	5	11	<1	3	1	1	<1	5
WME-16	Adjacent Alluvium	77	8	7	6	<1	1	<1	1	<1	2
WME-17	Adjacent Alluvium	77	8	9	4	<1	1	<1	1	<1	2

¹ Sample WME-14 also contained 13% of amorphous (non-crystalline) material.

Table 7. Summary of Scanning Electron Microscopy (SEM) Results for Homestake Tailings and Alluvial Solids¹

Sample	General Description and Silicate/Oxide Occurrence	Additional Observations / COC Associations
WME-2 (LTP Sands)	Brown, very fine to medium grained, silty sand with some clay. Quartz (55%) angular and rounded. Plagioclase (14%) angular and pitted. K-spar (14%) angular and subrounded. Clay content low (8%) as coatings on quartz, feldspar and as small masses; kaolinite and smectite; lesser chlorite, illite. Trace oxides (hematite, magnetite, Cu-oxide).	Feldspars contain rare earth phosphates. Calcite (8%) as liberated grains. Pyrite (1%) as liberated fragments and quartz inclusions. Minor chalcopryrite (CuFeS_2) in quartz, feldspar, pyrite. Barite as liberated grains and inclusions in quartz, feldspar. Native Se, FeSe_2 ; Se and V on pyrite surfaces. U grain ($\sim 10\mu\text{m}$) containing Ca, V.
WME-3 (LTP Sands)	Brown, very fine to medium grained, silty sand with some clay. Quartz (59%) angular and rounded. Plagioclase and K-spar (23%) angular to subangular with corroded grain boundaries and intragrain pitting. Clay (9%) primarily kaolinite, smectite as grain coatings and small masses. Oxides include hematite, magnetite, Cu-Sn oxide.	Feldspars with barite, zircon, and rare earth phosphates. Calcite (8%) as aggregates, liberated grains. Pyrite as liberated grains and with quartz, feldspar; chalcopryrite. Native Se, FeSe_2 , Pb-Cu selenide. U associated with yttrium phosphate containing V, As. U-Ti phase containing V, Fe.
WME-5 (LTP Slimes)	Grey with clayey silt texture. Quartz (45%) angular and rounded. Plagioclase/K-feldspar (24%) as angular fragments. Clay (>20%) primarily kaolinite, smectite; lesser chlorite, illite.	Calcite (8%) as fine dispersed grains (2-100 μm). Pyrite (1%) only sulfide identified. Trace iron oxide, barite, zircon. Native Se as liberated grains; Cu- and Pb-selenide. U-Ca-V within a grain of native Se.
WME-10 (STP Slimes)	Brown with fine to medium sand and moderate clay (smectite, kaolinite). Quartz (53%) angular and rounded, plagioclase and K-spar (28%) angular to subangular. Feldspars show mild grain boundary corrosion and intragrain pitting.	Feldspars contain small barite, zircon, rare earth phosphates, and pyrite. Pyrite shows replacement goethite (FeOOH) and chalcopryrite by Cu and Fe oxide. Calcite (9%) as small angular grains. Se, Pb-Se, and Cu-Se phases. U in association with Ti and Fe attached to Fe-oxide surfaces.
WME-14 (South Alluvium)	Brown coarse gravelly sand with appreciable clay (15%), mica/illite, kaolinite, smectite. Quartz (40%) angular to well-rounded. Plagioclase and K-spar as angular fragments. Volcanic glass (13%).	Major calcite (20%) with trace pyrite, chalcopryrite, barite, rutile, zircon. Se not apparent. No U-bearing phases could be identified.
WME-16 (Adjacent Alluvium)	Fine-medium grained sand with low clay (2%) (kaolinite, smectite). Angular to well-rounded quartz (77%) is the main silicate along with plagioclase (7%) and K-spar (8%).	Feldspars contain small pyrite, barite, rutile, zircon, and rare earth phosphate inclusions. Calcite (6%) is the sole carbonate. No U-bearing phases could be identified.

Table 8. General Solid Phase Characterization Results for Homestake Tailings and Alluvium Samples

Sample ID	Sample Type	Depth ft. bgs	Acid Generation Potential	Acid Neutralization Potential	Net Neutralization Potential	pH	Sulfide- Sulfur	Sulfate -Sulfur	Total- Sulfur	Cation Exchange Capacity cmolc/kg	Total Organic Carbon %
			-----kg CaCO ₃ /t-----			s.u.	----- % -----				
WME-1	LTP Sands	55	9.7	64	54.3	9.9	0.31	0.11	0.42	10.2	0.2
WME-2	LTP Sands	61	11.3	39	27.8	9.7	0.36	0.06	0.42	5.3	<0.10
WME-3	LTP Sands	65	7.2	41	33.8	9.9	0.23	0.01	0.24	3.4	<0.10
WME-4	LTP Slimes	65	6.6	61	54.4	10.3	0.21	0.12	0.33	12.6	0.3
WME-5	LTP Slimes	75	5.6	68	62.4	10.2	0.18	0.05	0.23	14.2	0.2
WME-6	LTP Slimes	65	8.8	79	70.3	10.2	0.28	0.11	0.39	14.4	0.3
WME-9	STP Sands	30	0.6	24.0	23.4	8.6	0.02	0.02	0.04	9.5	0.1
WME-10	STP Slimes	35	2.5	73.0	70.5	9.5	0.08	0.04	0.12	10.0	0.3
WME-7@108	LTP Perched Alluvium	108	<0.31	33	33	9.7	<0.01	0.01	0.01	7.0	<0.1
WME-7@114	LTP Vadose Alluvium	114	<0.31	31	31	9.6	<0.01	<0.01	<0.01	4.5	<0.1
WME-8@110	LTP Perched Alluvium	110	<0.31	28.0	28.0	8.7	<0.01	<0.01	<0.01	4.1	<0.10
WME-8@121	LTP Vadose Alluvium	121	<0.31	49.0	49.0	8.4	<0.01	<0.01	<0.01	4.2	<0.10
WME-11	North Alluvium	65	<0.31	95	95	8.4	<0.01	<0.01	<0.01	2.9	<0.10
WME-14	South Alluvium	45	<0.31	118	118	8.3	<0.01	<0.01	<0.01	7.7	0.10
WME-15	South Alluvium	55	<0.31	60	60	8.5	<0.01	0.02	0.02	4.2	<0.10
WME-16	Adjacent Alluvium	65	<0.31	49	49	8.7	<0.01	0.03	0.03	3.1	<0.10
WME-17	Adjacent Alluvium	55	<0.31	61	61	8.4	<0.01	0.04	0.04	6.1	<0.10

Table 9. Summary of the Selective Chemical Extraction Procedures for Tailings and Aquifer Solids

Extraction Step	Description	Reagent	Procedure
I	Water Soluble	Distilled water	1. Prepare sample by drying at 105 °C and grinding in agate mortar. 2. Weigh 2.0 g soil into 50 mL centrifuge tube. 3. Add 30 mL deionized H₂O. 4. Shake for 1 hr. 5. Centrifuge @ 12,000 g for 30 minutes. 6. Pipette supernatant into plastic syringe and filter through 0.45 µm pore-size syringe filter. 7. Analyze supernatant for U, V, Se, Mo, Ca, Mg, Na, Al, Fe, Mn, Si.
II	Exchangeable	1 M MgCl ₂ (pH = 7.0)	1. Add 16 mL of 1M MgCl₂ (pH = 7.0). 2. Shake for 1 hr. 3. Centrifuge @ 12,000 g for 30 minutes. 4. Pipette supernatant into plastic syringe and filter through 0.45 µm pore-size syringe filter. 5. Analyze supernatant for U, V, Se, Mo, Ca, Mg, Na, Al, Fe, Mn, Si. 6. Add 16 mL deionized H₂O into centrifuge tube containing the solid sample and hand shake for 1 minute. 7. Centrifuge @ 12,000 g for 30 minutes. 8. Pipette and discard supernatant.
III	Carbonate Bound	1 M NaOAc (pH = 5.0)	1. Add 16 mL of 1M NaOAc (adjusted to pH = 5 with HOAc). 2. Shake for 2.5 hr. 3. Repeat steps 3 through 8 in Extraction Step II.
IV	Oxide Bound	0.04 M NH ₂ OH·HCl in 25% (v/v) HOAc	1. Add 40 mL of 0.04 M NH₂OH·HCl in 25% (v/v) HOAc (pH ≈ 2). 2. Hand shake for 1 minute. 3. Place in oven at 96 ± 3 °C for 6 hrs. Hand shake every 1 hr. 4. After 6 hrs. remove from oven and hand shake. 5. Repeat steps 3 through 8 in Extraction Step II.
V	Organic Bound	0.02 M HNO ₃ / 3.2 M NH ₄ OAc	1. Add 6 mL of 0.02 M HNO₃. 2. Add 10 mL of 30% H₂O₂ adjusted to pH = 2 with HNO₃. 3. Hand shake for 1 minute. 4. Place into oven at 85 ± 2 °C for 2 hours. 5. Hand shake for 1 minute after 1 hour and 2 hours. 6. Add 6 mL H₂O₂ (pH = 2 with HNO₃) and hand shake for 1 minute. 7. Heat to 85 ± 2 °C for 3 hours. Shake for 1 minute each hour. 8. Allow sample to cool to room temperature. 9. Add 10 mL of 3.2 M NH₄OAc in 20% (v/v) HNO₃. 10. Add 8 mL deionized H₂O. 11. Shake for 30 minutes. 12. Repeat steps 3 through 8 in Extraction Step II.
VI	Residual	HF/HNO ₃	1. Digest final residue using EPA Method 3052. 2. Analyze digest for U, V, Se, Mo, Ca, Mg, Na, Al, Fe, Mn, Si.

Table 10. Percent Distribution of Species for Uranium, Selenium, and Molybdenum for North, West, South, and Underlying Alluvial Wells.

Location	Date	Uranium					Selenium	Molybdenum
		UO ₂ (CO ₃) ₃ ⁴⁻	CaUO ₂ (CO ₃) ₃ ²⁻	Ca ₂ UO ₂ (CO ₃) ₃	MgUO ₂ (CO ₃) ₃ ²⁻	UO ₂ (CO ₃) ₂ ²⁻	SeO ₄ ²⁻	MoO ₄ ²⁻
DD	3/21/2018	1.31	18.54	79.92	0.05	0.17	100.0	99.9
DD	6/21/2018	1.15	17.15	81.56	0.04	0.09	100.0	100.0
DD	9/17/2018	0.99	18.80	80.02	0.05	0.14	100.0	99.9
DD	12/5/2018	1.44	18.63	79.78	0.06	0.09	100.0	100.0
Q	3/20/2018	0.77	18.32	80.68	0.04	0.19	100.0	100.0
Q	6/20/2018	0.75	17.38	81.71	0.04	0.12	100.0	100.0
Q	9/13/2018	0.77	17.71	81.38	0.04	0.11	100.0	100.0
Q	12/3/2018	0.98	18.93	79.96	0.05	0.10	100.0	100.0
R	3/21/2018	0.81	20.37	78.65	0.04	0.13	100.0	100.0
R	6/20/2018	0.75	19.21	79.91	0.04	0.09	100.0	100.0
R	9/12/2018	0.77	19.52	79.57	0.04	0.10	100.0	100.0
R	12/3/2018	1.02	20.78	78.01	0.04	0.14	100.0	100.0
M19	4/4/2018	0.73	22.11	76.94	0.07	0.15	100.0	99.9
M19	6/21/2018	0.67	20.89	78.25	0.06	0.13	100.0	99.9
M19	10/1/2018	0.72	20.98	78.13	0.07	0.10	100.0	99.9
M19	12/12/2018	0.78	20.92	78.13	0.07	0.10	100.0	99.9
MR	3/22/2018	0.66	22.08	76.75	0.07	0.43	100.0	99.8
MR	6/13/2018	0.67	20.81	78.33	0.06	0.13	100.0	99.9
MR	9/17/2018	0.96	21.70	77.11	0.07	0.15	100.0	99.9
S4	3/22/2018	0.82	21.23	77.48	0.06	0.39	100.0	99.8
S4	6/13/2018	0.68	21.82	77.29	0.07	0.14	100.0	99.9
S4	9/18/2018	0.90	23.27	75.62	0.07	0.14	100.0	99.9
S4	12/5/2018	0.94	23.78	75.07	0.08	0.12	100.0	100.0
D1	3/22/2018	1.35	25.77	72.34	0.07	0.46	100.0	99.9
D1	6/12/2018	0.99	23.52	75.10	0.06	0.34	100.0	99.9
D1	9/17/2018	1.12	24.93	73.68	0.06	0.19	100.0	99.9
D1	12/5/2018	1.12	25.75	72.94	0.07	0.12	100.0	100.0
X	3/22/2018	0.77	23.48	75.20	0.07	0.47	100.0	99.9
X	6/13/2018	0.65	24.60	74.47	0.07	0.22	100.0	99.9
X	9/17/2018	0.62	23.94	75.22	0.06	0.14	100.0	100.0

Table 10. Percent Distribution of Species for Uranium, Selenium, and Molybdenum for North, West, South, and Underlying Alluvial Wells (Continued).

Location	Date	Uranium					Selenium	Molybdenum
		$\text{UO}_2(\text{CO}_3)_3^{4-}$	$\text{CaUO}_2(\text{CO}_3)_3^{2-}$	$\text{Ca}_2\text{UO}_2(\text{CO}_3)_3$	$\text{MgUO}_2(\text{CO}_3)_3^{2-}$	$\text{UO}_2(\text{CO}_3)_2^{2-}$	SeO_4^{2-}	MoO_4^{2-}
X	12/5/2018	0.67	25.32	73.80	0.07	0.14	100.0	100.0
F	3/24/2018	0.92	21.36	77.46	0.06	0.20	100.0	99.9
F	6/11/2018	0.86	22.06	76.86	0.07	0.15	100.0	99.9
F	9/26/2018	0.83	20.52	78.48	0.06	0.12	100.0	99.9
F	12/11/2018	0.89	21.07	77.85	0.07	0.12	100.0	99.9
I	4/4/2018	0.87	26.22	72.59	0.08	0.23	100.0	99.9
I	6/19/2018	0.71	25.06	73.95	0.07	0.20	100.0	99.9
I	9/27/2018	0.78	24.59	74.43	0.07	0.12	100.0	100.0
I	12/12/2018	0.83	25.25	73.70	0.08	0.14	100.0	100.0
T2	4/9/2018	89.19	7.11	3.61	0.07	0.02	100.0	100.0
T2	6/21/2018	87.75	7.81	4.36	0.07	0.02	100.0	100.0
T2	9/18/2018	90.37	6.61	2.94	0.06	0.01	100.0	100.0
T2	12/11/2018	90.95	6.45	2.53	0.07	0.01	100.0	100.0
T20	3/23/2018	24.62	27.77	47.11	0.10	0.41	100.0	99.9
T20	6/27/2018	24.47	27.54	47.59	0.09	0.30	100.0	99.9
T20	9/24/2018	24.89	26.00	48.92	0.08	0.11	100.0	100.0
T20	12/11/2018	26.97	25.67	47.17	0.09	0.11	100.0	100.0
T22	4/3/2018	44.68	40.06	14.87	0.24	0.15	100.0	100.0
T22	6/27/2018	62.74	19.62	17.38	0.15	0.11	100.0	100.0
T22	9/24/2018	44.70	26.09	28.98	0.19	0.04	100.0	100.0
T22	12/11/2018	62.16	19.06	18.60	0.14	0.04	100.0	100.0
WME-9	8/20/2018	2.08	39.35	58.14	0.13	0.30	100.0	100.0
WME-9	11/14/2018	2.15	41.12	56.43	0.15	0.15	100.0	100.0
WME-9	2/27/2019	0.87	29.79	69.17	0.09	0.08	100.0	100.0
WME-9	5/22/2019	0.60	29.20	70.00	0.08	0.12	100.0	100.0
WME-10	8/20/2018	0.66	27.41	71.57	0.07	0.29	100.0	99.9
WME-10	11/14/2018	0.66	27.62	71.52	0.07	0.13	100.0	100.0
WME-10	2/27/2019	0.64	27.09	72.09	0.07	0.11	100.0	100.0
WME-10	5/22/2019	0.60	26.96	72.31	0.07	0.07	100.0	100.0

Table 11. Saturation Index (SI) Values for Various Uranium, Selenium, and Molybdenum Minerals for North, West, South, and Underlying Alluvial Wells

Location	Date	Calcite	Amorphous Aluminum Hydroxide	Ferrihydrite	Quartz	Amorphous Uranium Oxide	Uraninite	Tyuyamunite	Carnotite	Native Selenium	Calcium Molybdate
		CaCO ₃	Al(OH) ₃ (am)	Fe(OH) ₃ (am)	SiO ₂	UO ₂ (am)	UO ₂ (c)	Ca(UO ₂)(VO ₄) ₂ ·(5-8)H ₂ O	K ₂ O·2UO ₃ ·V ₂ O ₅	Se(am)	CaMoO ₄
DD	3/21/2018	0.24	-2.3	0.8	0.55	-34.4	-28.6	-8.0	-4.6	-57.5	-2.22
DD	6/21/2018	0.45	-2.2	1.2	0.62	-34.8	-29.0	-8.8	-5.0	-58.2	-2.88
DD	9/17/2018	0.40	-1.2	1.4	0.55	-34.1	-28.4	-8.3	-4.9	-56.5	-2.45
DD	12/5/2018	0.49	-1.3	1.3	0.63	-35.1	-29.2	-9.0	-5.1	-59.0	-1.81
Q	3/20/2018	0.18	-1.8	1.6	0.58	-33.9	-28.1	-7.9	-4.5	-55.6	-2.91
Q	6/20/2018	0.34	-1.3	2.0	0.63	-34.9	-29.1	-8.5	-4.8	-58.1	-2.98
Q	9/13/2018	0.38	-2.3	1.2	0.61	-34.8	-29.0	-8.7	-4.9	-57.7	-2.94
Q	12/3/2018	0.42	-1.4	1.4	0.65	-35.1	-29.2	-8.9	-4.9	-58.7	-2.63
R	3/21/2018	0.38	-1.6	1.5	0.60	-34.4	-28.6	-8.5	-4.9	-57.1	-2.67
R	6/20/2018	0.49	-1.4	2.3	0.64	-34.7	-29.0	-9.0	-5.3	-57.6	-1.66
R	9/12/2018	0.47	-2.8	1.3	0.62	-34.7	-28.9	-9.0	-5.3	-57.6	-2.65
R	12/3/2018	0.30	-1.4	1.5	0.67	-35.1	-29.3	-8.8	-5.1	-59.2	-2.69
M19	4/4/2018	0.34	-1.5	2.4	0.67	-33.9	-28.1	-7.4	-4.3	-57.3	-0.40
M19	6/21/2018	0.38	-1.2	1.7	0.71	-34.1	-28.4	-7.7	-4.4	-57.6	-0.40
M19	10/1/2018	0.48	-2.2	1.6	0.69	-34.3	-28.5	-8.0	-4.5	-57.9	-0.34
M19	12/12/2018	0.43	-1.2	1.8	0.74	-34.5	-28.7	-11.7	-6.4	-58.3	-0.40
MR	3/22/2018	-0.01	-1.0	1.7	0.64	-32.9	-27.3	-6.4	-3.8	-54.3	-1.23
MR	6/13/2018	0.43	-1.2	2.0	0.67	-33.8	-28.1	-7.6	-4.4	-56.2	-1.22
MR	9/17/2018	0.32	-1.2	1.6	0.79	-34.3	-28.5	-9.2	-5.0	-58.0	-1.25
S4	3/22/2018	-0.12	-1.2	1.1	0.79	-34.5	-28.7	-8.0	-4.6	-57.8	-0.53
S4	6/13/2018	0.37	-1.2	1.7	0.72	-34.7	-28.9	-8.9	-5.2	-57.4	-0.50
S4	9/18/2018	0.35	-1.2	1.6	0.79	-35.1	-29.3	-9.1	-5.2	-58.9	-0.52
S4	12/5/2018	0.40	-1.2	1.2	0.77	-35.1	-29.3	-9.2	-5.2	-59.1	-0.50
D1	3/22/2018	-0.16	-2.6	0.7	0.78	-33.5	-27.6	-6.6	-3.8	-58.6	0.31
D1	6/12/2018	-0.04	-1.1	0.9	0.73	-33.6	-27.8	-5.9	-3.7	-58.4	0.11
D1	9/17/2018	0.21	-2.7	0.9	0.82	-33.9	-28.0	-7.4	-4.4	-59.1	0.27
D1	12/5/2018	0.41	-1.3	1.3	0.76	-34.2	-28.4	-9.2	-5.3	-59.9	0.01
X	3/22/2018	-0.20	-2.5	1.9	0.46	-34.6	-28.8	-8.1	-4.5	-59.1	-1.20
X	6/13/2018	0.17	-1.9	1.2	0.49	-35.0	-29.2	-9.1	-5.1	-59.3	-1.11
X	9/17/2018	0.35	-2.4	1.7	0.54	-34.8	-29.1	-8.762	-4.9	-59.4	-0.95

Table 11. Saturation Index (SI) Values for Various Uranium, Selenium, and Molybdenum Minerals for North, West, and South Alluvial Wells (Continued).

Location	Date	Calcite CaCO ₃	Amorphous Aluminum Hydroxide Al(OH) ₃ (am)	Ferrihydrite Fe(OH) ₃ (am)	Quartz SiO ₂	Amorphous Uranium Oxide UO ₂ (am)	Uraninite UO ₂ (c)	Tyuyamunite Ca(UO ₂)(VO ₄) ₂ · (5-8)H ₂ O	Carnotite K ₂ O·2UO ₃ ·V ₂ O ₅	Native Selenium Se(am)	Calcium Molybdate CaMoO ₄
X	12/5/2018	0.36	-1.4	1.3	0.55	-35.0	-29.2	-8.9	-5.1	-59.8	-0.99
F	3/24/2018	0.13	-2.4	0.5	1.00	-35.6	-29.7	-10.4	-5.8	-59.4	-3.00
F	6/11/2018	0.30	-2.0	1.5	0.98	-35.5	-29.7	-9.7	-5.4	-59.0	-1.98
F	9/26/2018	0.36	-1.6	1.2	0.99	-35.6	-29.8	-11.1	-6.1	-59.8	-2.68
F	12/11/2018	0.33	-1.2	1.0	1.02	-35.7	-29.9	-11.2	-6.2	-59.7	-3.38
I	4/4/2018	0.14	-2.5	1.8	0.93	-35.0	-29.2	-9.6	-5.5	-59.8	-3.12
I	6/19/2018	0.21	-1.2	0.7	0.91	-34.7	-29.0	-9.3	-5.4	-59.3	-3.19
I	9/27/2018	0.39	-2.5	0.9	0.95	-35.4	-29.6	-10.3	-5.7	-60.3	-3.24
I	12/12/2018	0.35	-1.3	1.3	0.97	-35.4	-29.5	-10.4	-5.9	-60.3	-3.30
T2	4/9/2018	0.97	-1.7	2.8	0.68	-35.0	-29.2	-10.9	-5.6	-58.0	0.78
T2	6/21/2018	1.14	-1.8	2.4	0.73	-34.9	-29.1	-11.4	-5.8	-57.3	0.81
T2	9/18/2018	1.22	-2.2	3.2	0.60	-35.2	-29.4	-11.8	-6.0	-58.4	0.66
T2	12/11/2018	1.27	-1.7	2.7	0.66	-35.4	-29.6	-12.4	-6.3	-59.1	0.69
T20	3/23/2018	0.16	-1.9	3.0	0.73	-33.1	-27.3	-6.1	-3.4	-56.1	0.98
T20	6/27/2018	0.29	-1.8	3.6	0.76	-33.4	-27.6	-6.4	-3.6	-56.7	1.03
T20	9/24/2018	0.70	-1.6	3.8	0.75	-34.0	-28.2	-7.4	-4.1	-57.6	1.04
T20	12/11/2018	0.70	-1.3	3.6	0.79	-34.0	-28.2	-9.4	-5.1	-57.8	0.99
T22	4/3/2018	0.68	-2.4	2.7	0.42	-33.4	-27.7	-7.7	-4.0	-56.8	0.29
T22	6/27/2018	0.66	-1.7	-----	0.68	-33.8	-28.1	-6.9	-3.5	-57.1	0.90
T22	9/24/2018	1.17	-2.6	2.4	0.66	-34.2	-28.4	-8.1	-4.1	-57.6	0.91
T22	12/11/2018	1.09	-1.4	2.6	0.72	-34.5	-28.7	-8.2	-4.2	-58.3	0.87
WME-9	8/20/2018	0.27	-1.2	2.2	0.86	-33.7	-27.9	-7.3	-4.0	-58.5	-0.15
WME-9	11/14/2018	0.59	-2.4	2.8	0.80	-33.7	-28.0	-11.0	-5.9	-59.0	-0.26
WME-9	2/27/2019	0.71	-3.1	3.2	0.39	-34.1	-28.4	-8.6	-4.7	-58.5	-0.66
WME-9	5/22/2019	0.64	-1.9	2.7	0.63	-33.6	-28.0	-8.4	-4.9	-56.2	-0.82
WME-10	8/20/2018	0.16	-2.2	1.2	0.83	-33.4	-27.7	-5.5	-3.4	-55.9	-0.69
WME-10	11/14/2018	0.49	-1.5	2.5	0.83	-34.2	-28.5	-6.4	-4.0	-57.6	-0.72
WME-10	2/27/2019	0.58	-0.8	3.3	0.85	-34.3	-28.6	-6.9	-4.1	-57.8	-0.73
WME-10	5/22/2019	0.77	-1.8	3.8	0.77	-34.3	-28.7	-7.1	-4.4	-57.5	-0.75

Table 12. Pore Volume Calculations and Leachate Results (mg/L) for MWMP Testing of Alluvium Samples

Parameter	WME-7 (108') Perched			WME-7 (114') - Vadose			WME-8 (110') - Perched			WME-8 (121') - Vadose		
Material Mass (g)	5000			5000			5000			5000		
Total Porosity	0.3			0.3			0.3			0.3		
Particle Density (g/cm ³)	2.65			2.65			2.65			2.65		
Bulk Density (g/cm ³)	1.86			1.86			1.86			1.86		
Material Volume (L)	2.7			2.7			2.7			2.7		
Effective Porosity	0.2			0.2			0.2			0.2		
One Pore Volume (L)	0.54			0.54			0.54			0.54		
Leachate Volume (L)	5			5			5			5		
Leach No.	1	2	3	1	2	3	1	2	3	1	2	3
Pore Volumes	9	19	28	9	19	28	9	19	28	9	19	28
pH	9.8	10.3	10.3	9.7	9.9	9.9	8.9	9.5	9.4	8.7	9.2	9
Alkalinity as CaCO ₃	422	202	141	290	165	93.6	128	90.3	59.7	114	62.3	42
Aluminum	0.12	0.29	0.24	0.35	0.73	0.43	0.08	0.1	0.07	<0.03	0.05	0.08
Calcium	1.7	0.6	0.4	0.7	0.4	0.2	5.2	1	1.9	26	3.3	4.6
Chloride	61.4	5.1	2.1	38.8	10.3	1.1	24.3	1.4	<0.5	24.4	<0.5	<0.5
Fluoride	1.28	0.73	0.37	1.92	0.79	0.27	1.24	0.63	0.39	3.02	0.91	0.47
Iron	0.25	0.21	0.16	0.45	0.56	0.28	0.12	0.1	0.06	<0.02	0.04	0.05
Magnesium	0.3	<0.2	<0.2	<0.2	<0.2	<2	1.4	<0.2	0.4	9.3	0.9	1.3
Molybdenum	1.61	0.17	0.09	3.13	0.61	0.14	2.2	0.71	0.43	2.4	0.4	0.21
Potassium	1.5	0.7	0.7	0.7	0.6	0.5	1.5	0.9	0.9	2.5	1.3	1.6
Selenium	0.304	0.16	0.1	0.563	0.275	0.082	0.128	0.0876	0.0592	0.02	0.0117	0.008
Silicon	8.8	7.2	5.1	10.6	7.3	5.8	8.9	7.8	6	10.6	8.3	7.3
Sulfate	367	36.6	18.4	257	41.7	10.4	179	25.4	10.7	246	10.3	4.5
Sodium	379	107	71.2	262	101	46.5	149	46	27.8	130	26.2	11.8
Uranium	0.599	0.0687	0.0348	0.57	0.17	0.0495	0.25	0.06	0.0296	0.194	0.0288	0.0126
Vanadium	0.248	0.131	0.082	0.029	0.013	0.009	0.016	0.022	0.021	0.007	0.008	<0.005

Figures

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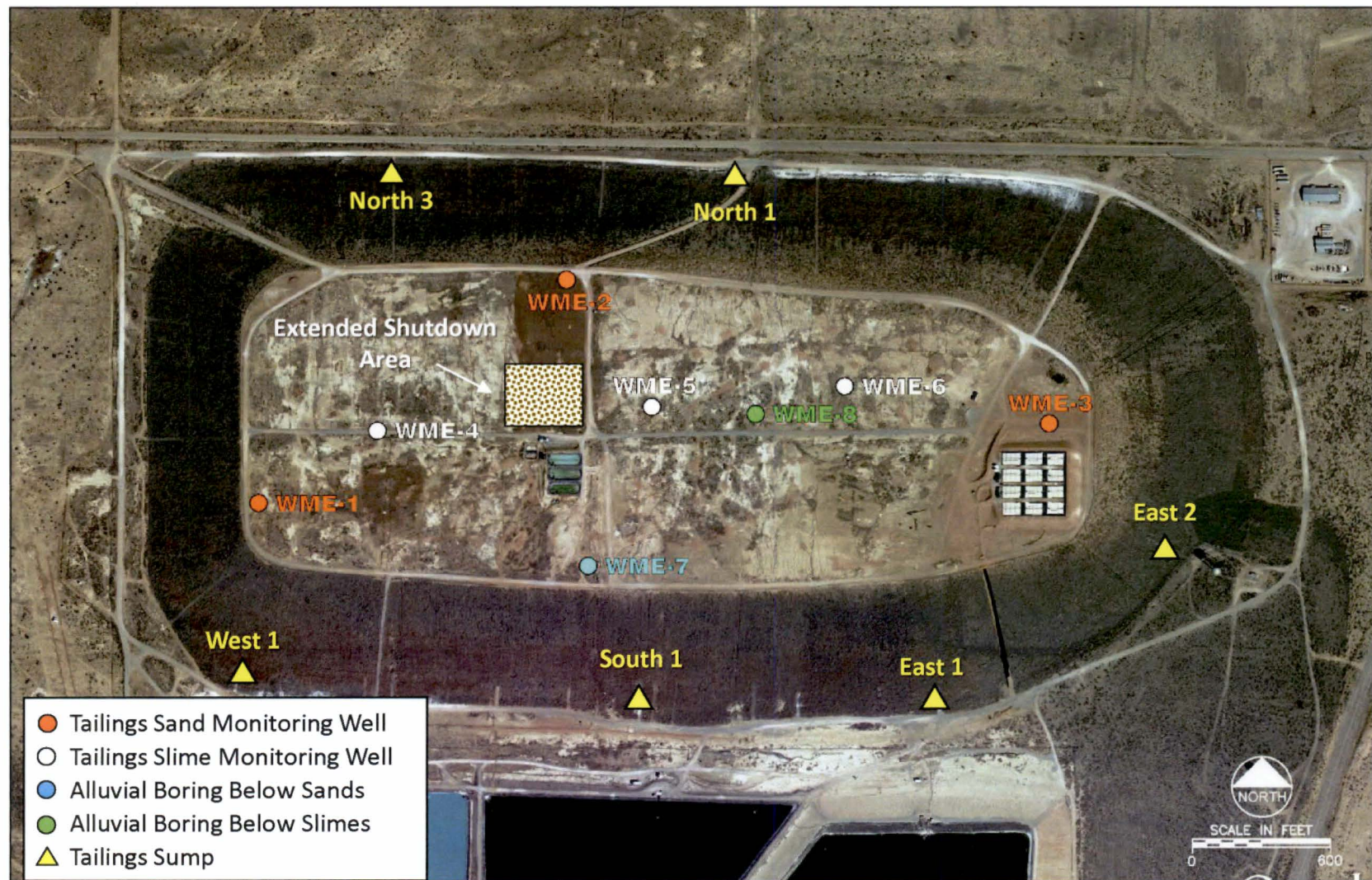


Figure 1. Location of New LTP Wells and Alluvial Borings for Solids Collection and Water Quality Evaluation.



Figure 2. Location of New STP Wells for Solids Collection and Water Quality Evaluation.



Figure 3. Location of Alluvial Borings and Wells for Solids Collection and Water Quality Evaluation.

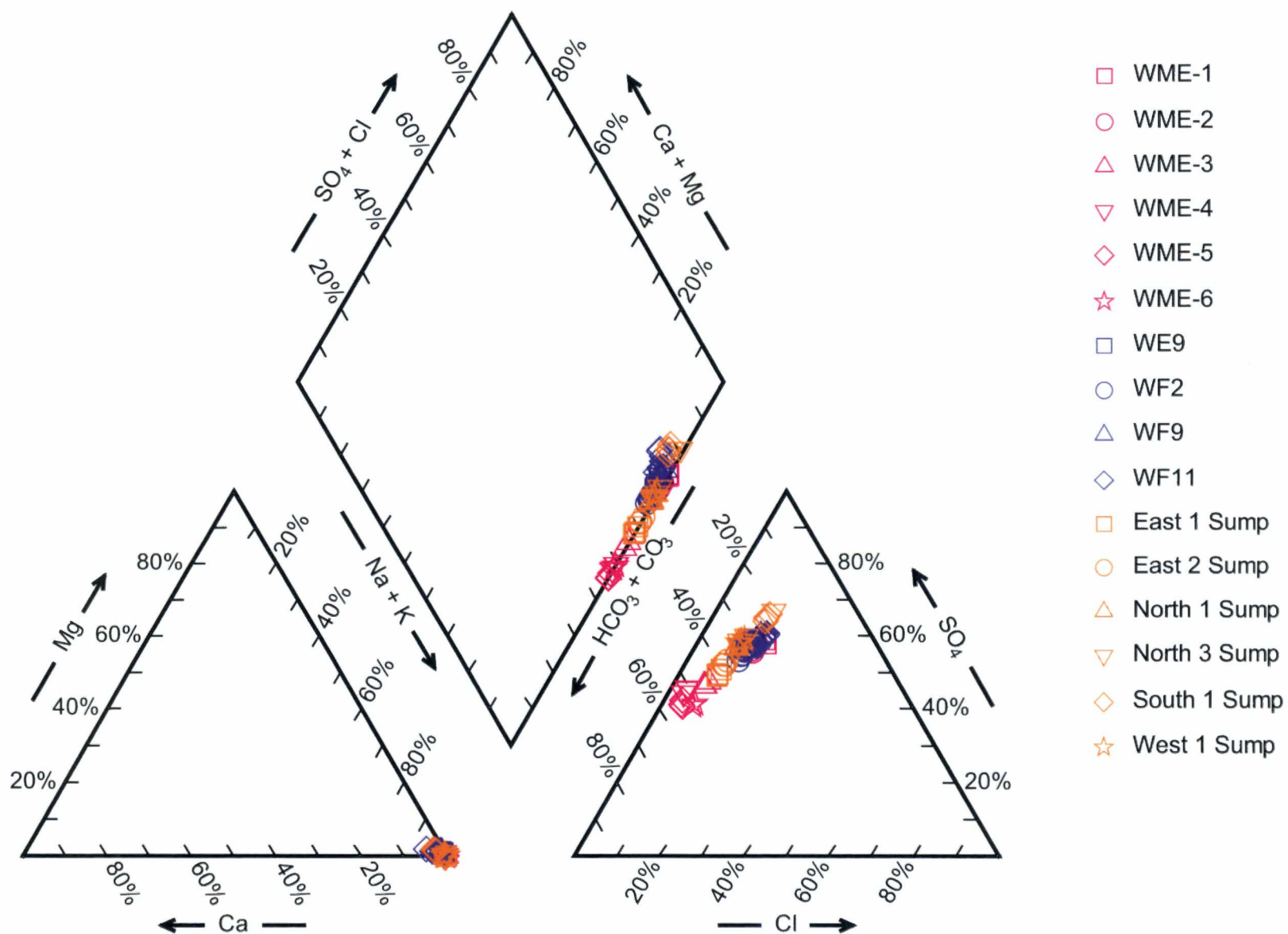


Figure 4. Trilinear Diagram for the LTP Wells and Sumps (2018).

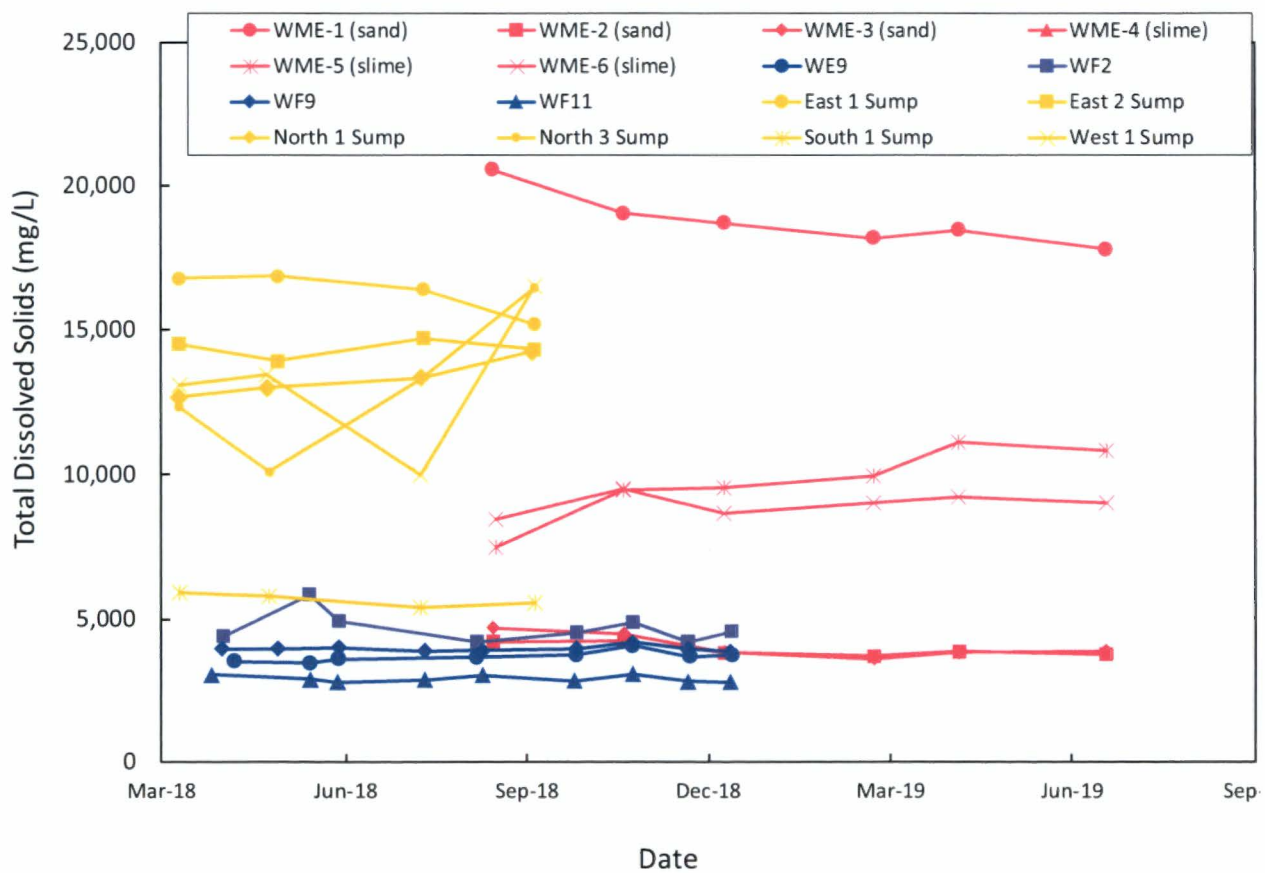
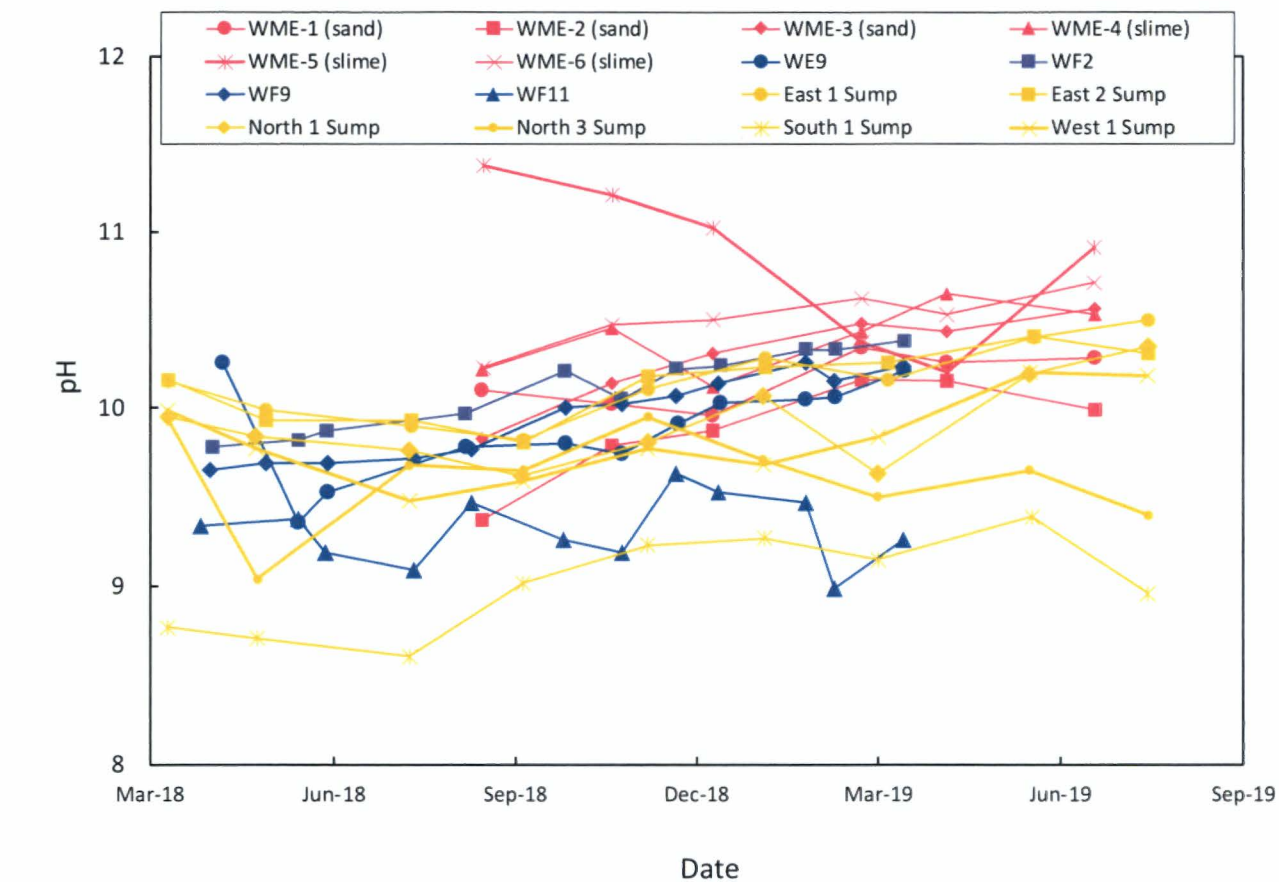


Figure 5. pH and TDS for the LTP Wells and Sumps Evaluated.

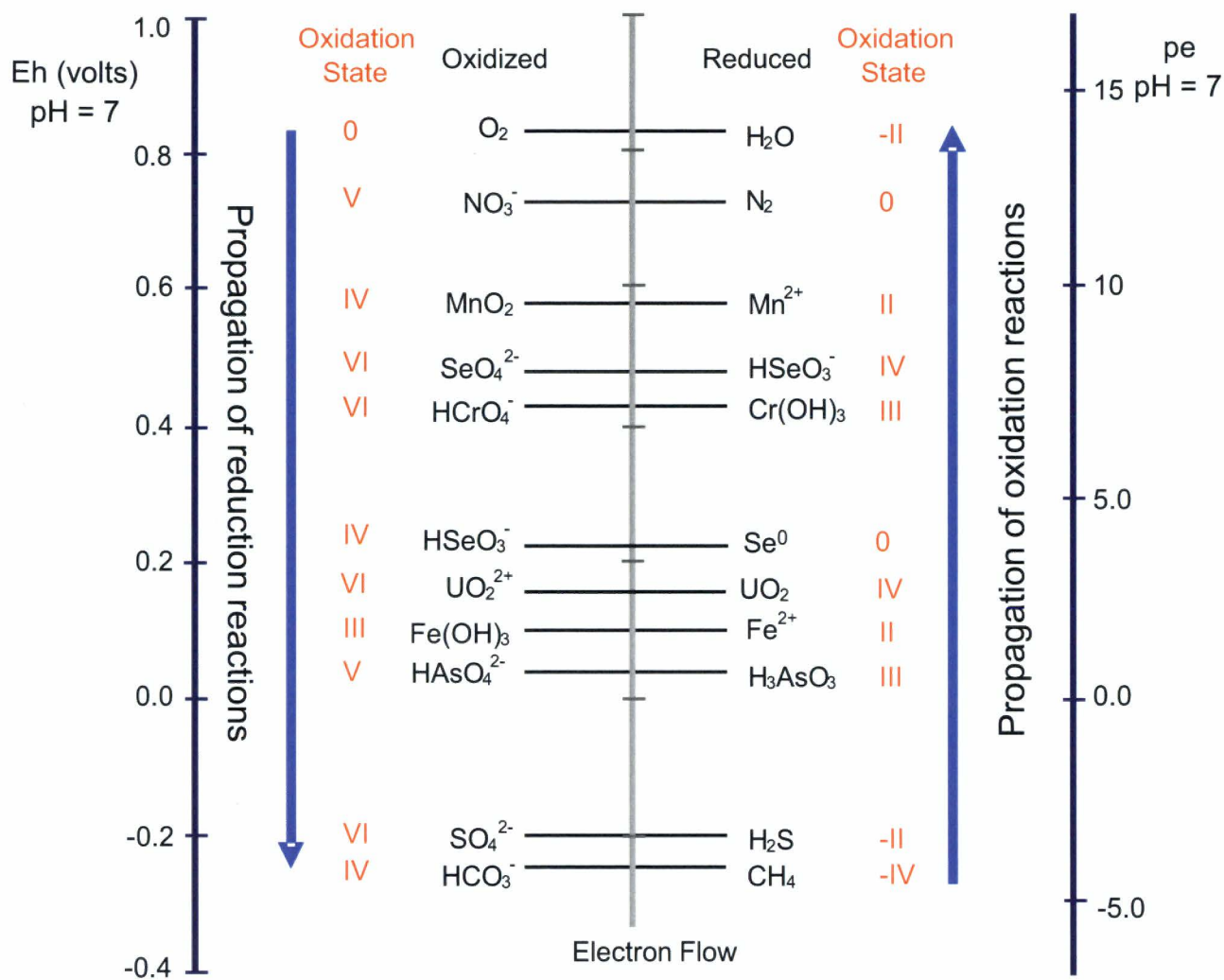


Figure 6. Generalized Redox Ladder Showing Sequence of Reduction for Various Species.

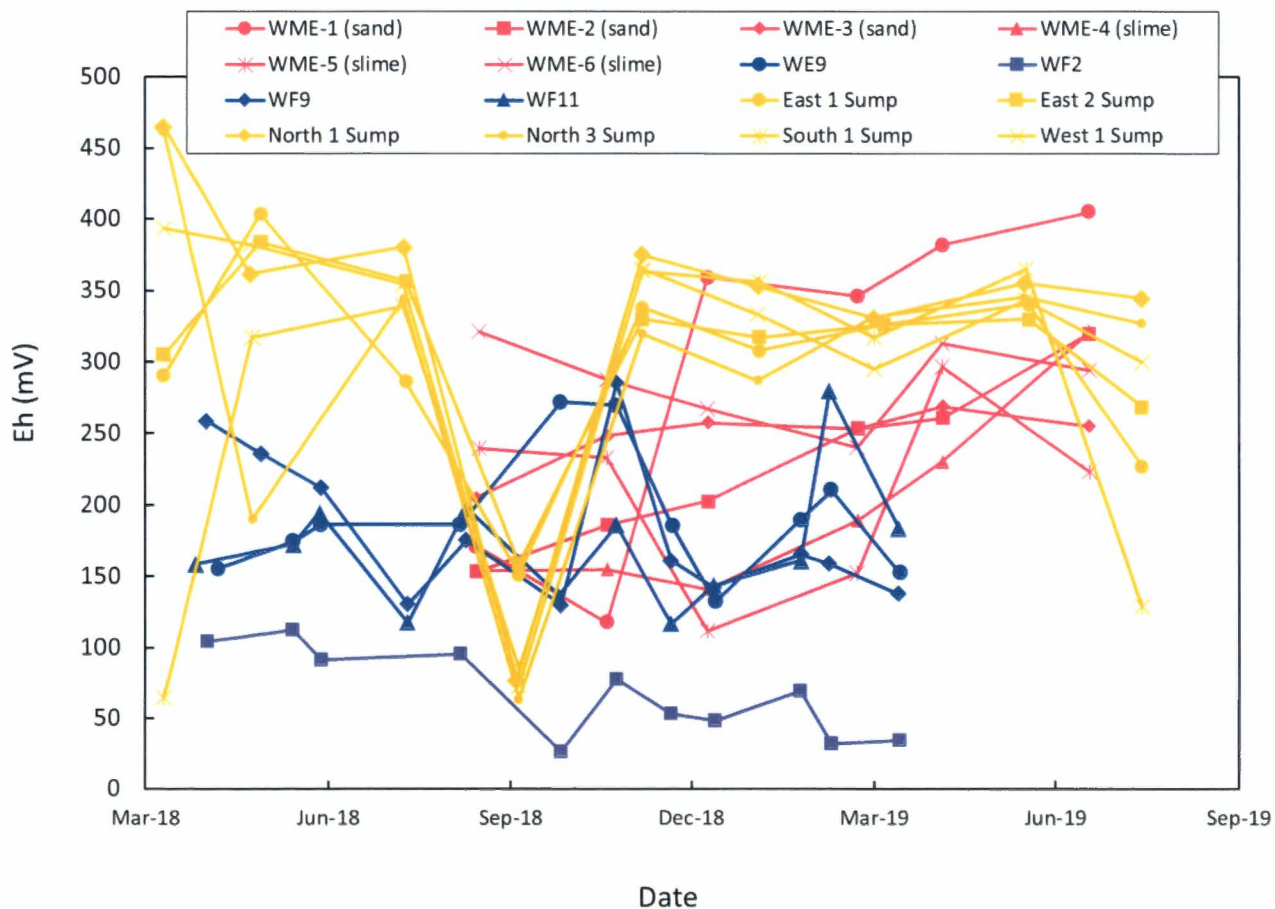
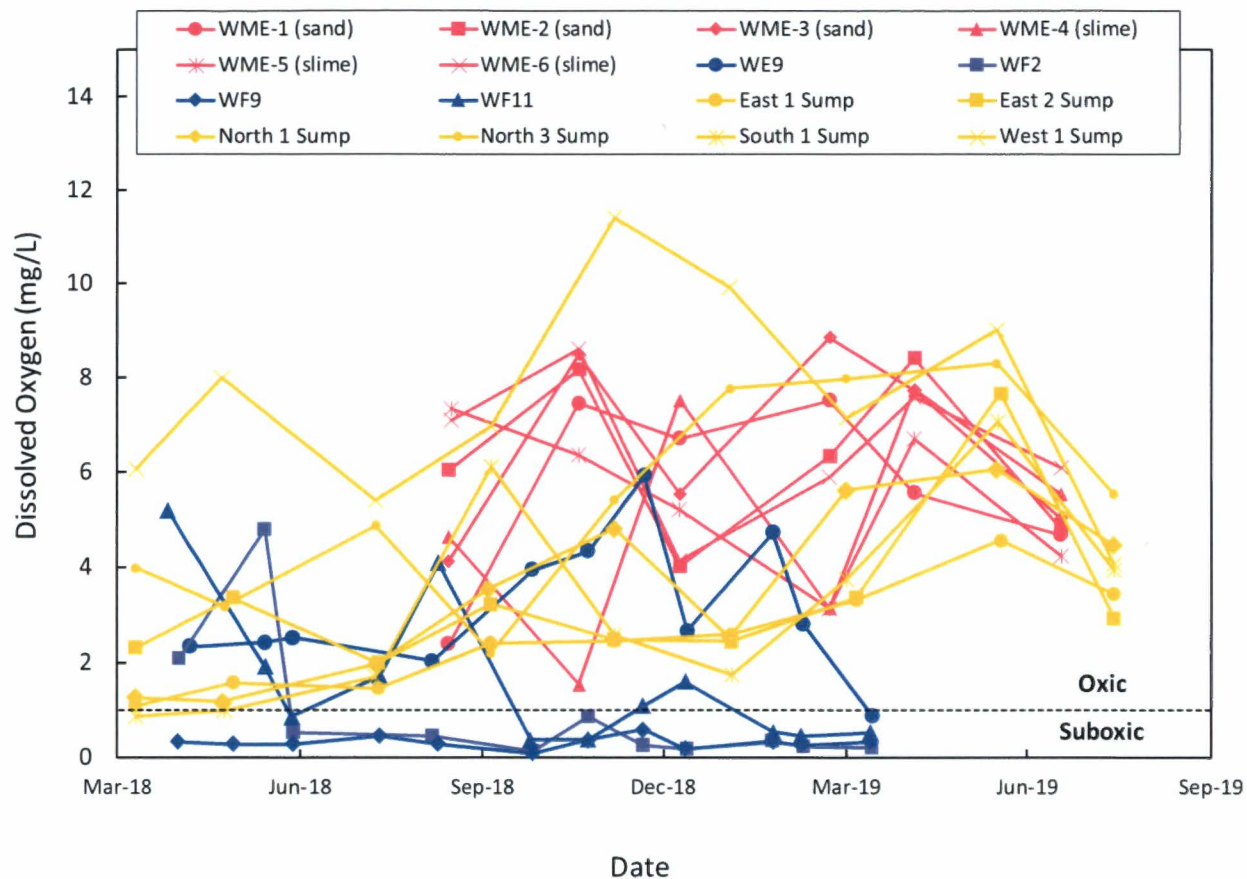


Figure 7. Dissolved Oxygen and Calculated Eh for the LTP Wells and Sumps Evaluated.

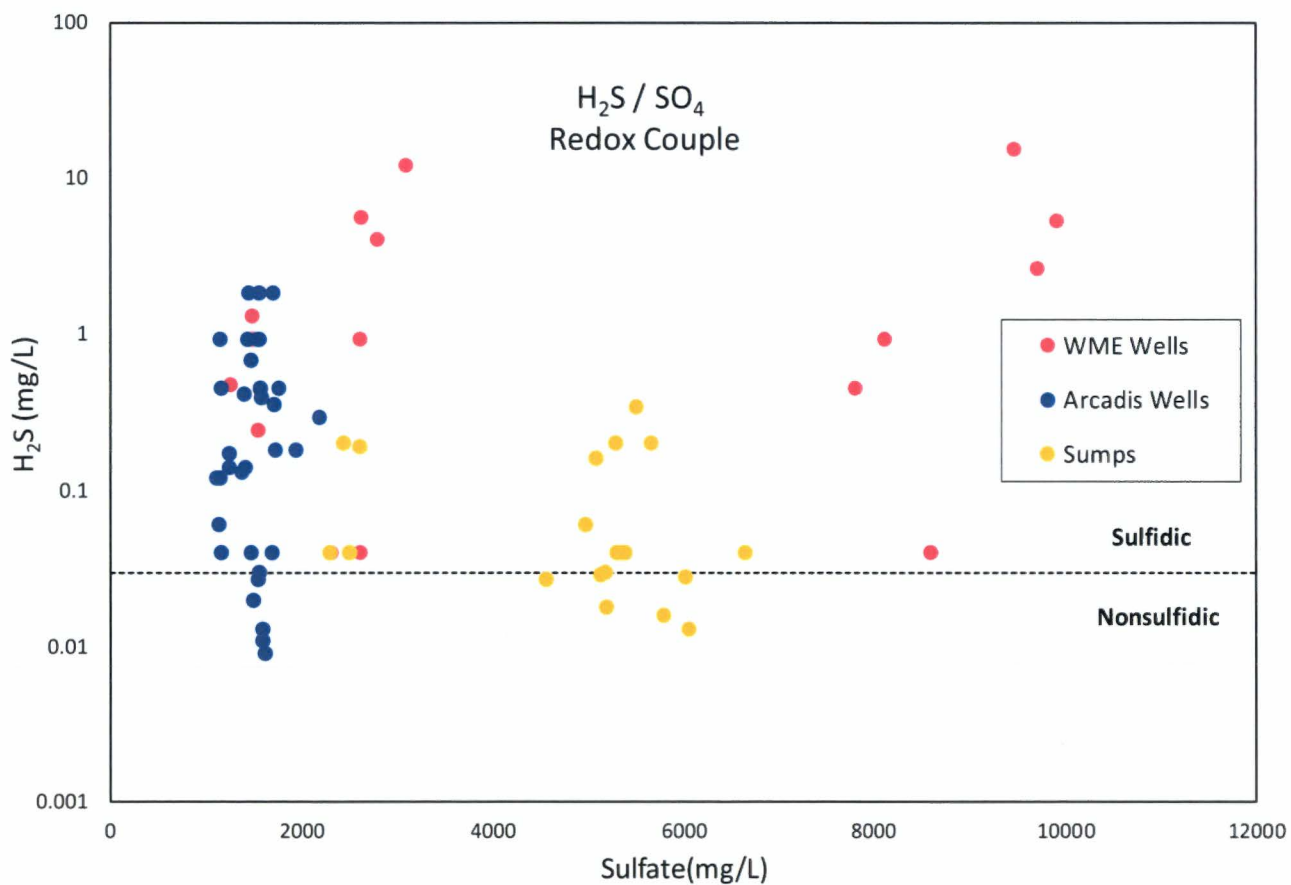
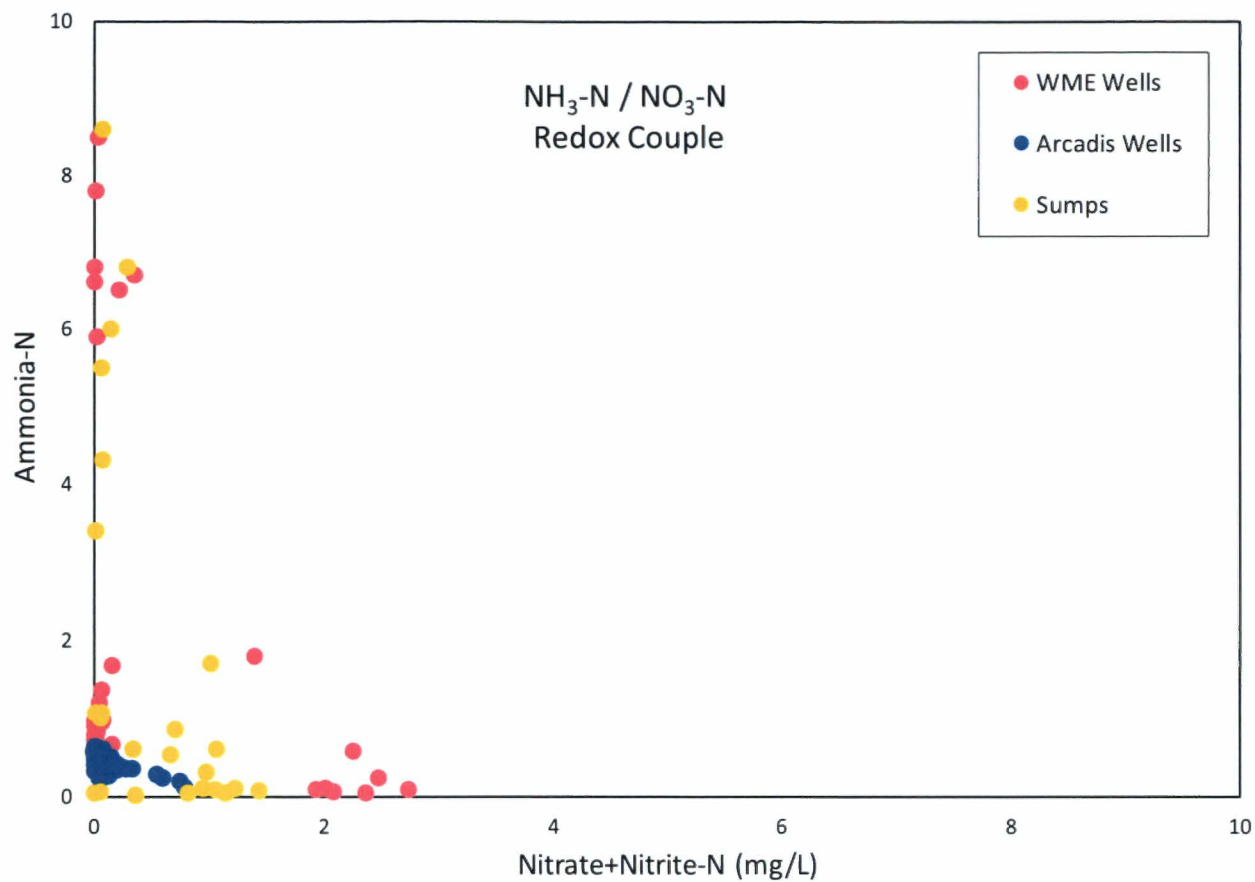


Figure 8. Comparison of Ammonia-N vs. Nitrate-N and Sulfide vs. Sulfate Concentrations in LTP Wells and Sumps.

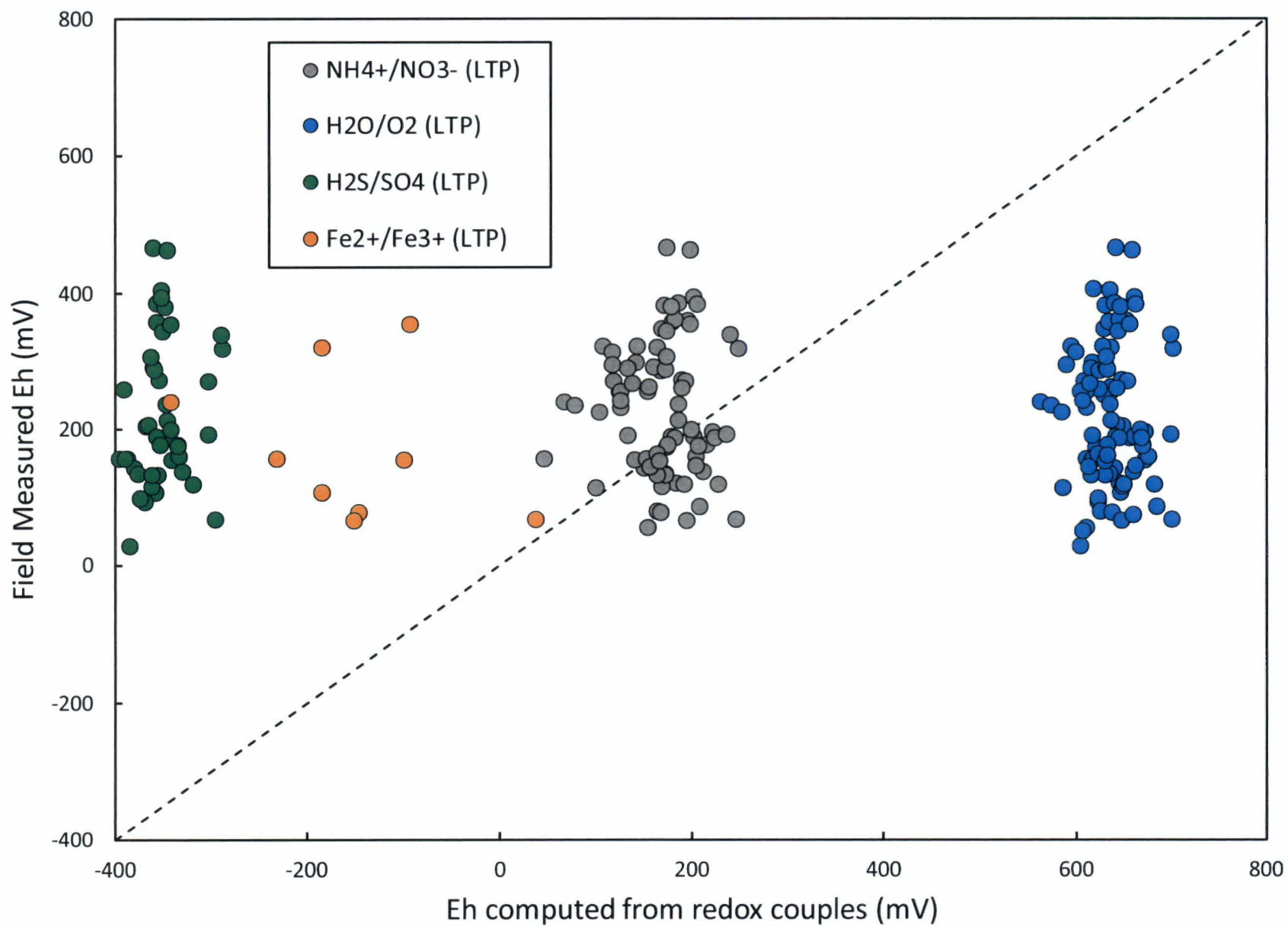


Figure 9. Comparison of Field-Measured Groundwater Eh and Potentials Computed from Individual Redox Couples for the LTP Wells and Sumps.

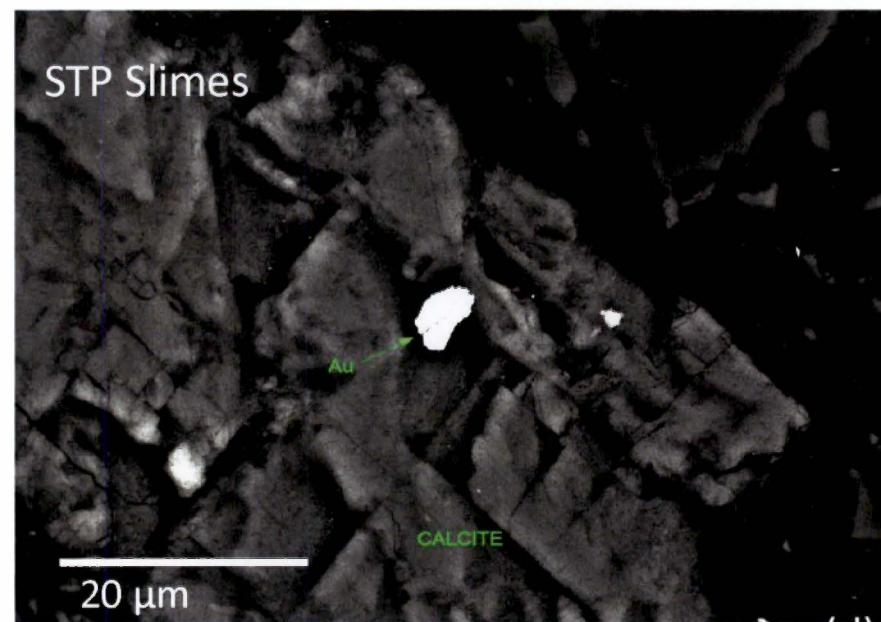
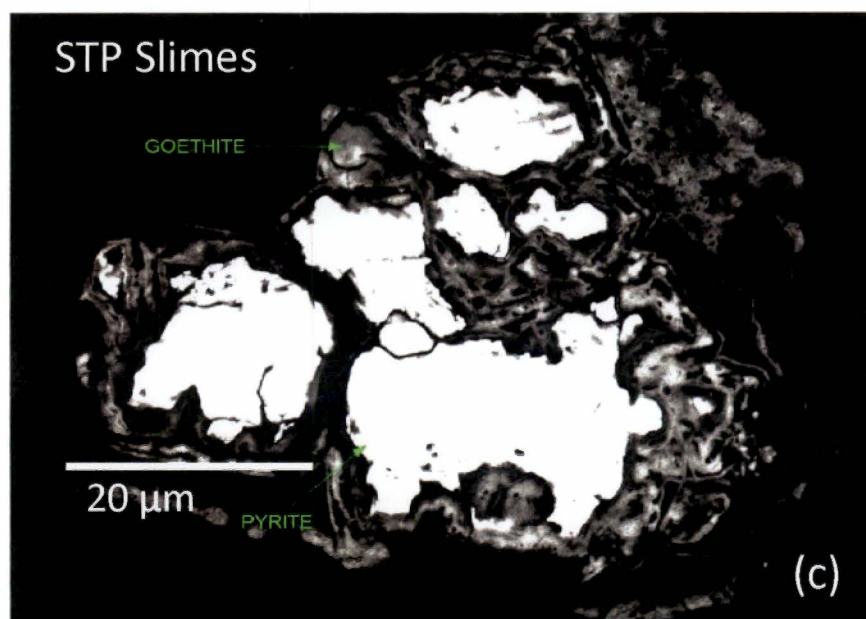
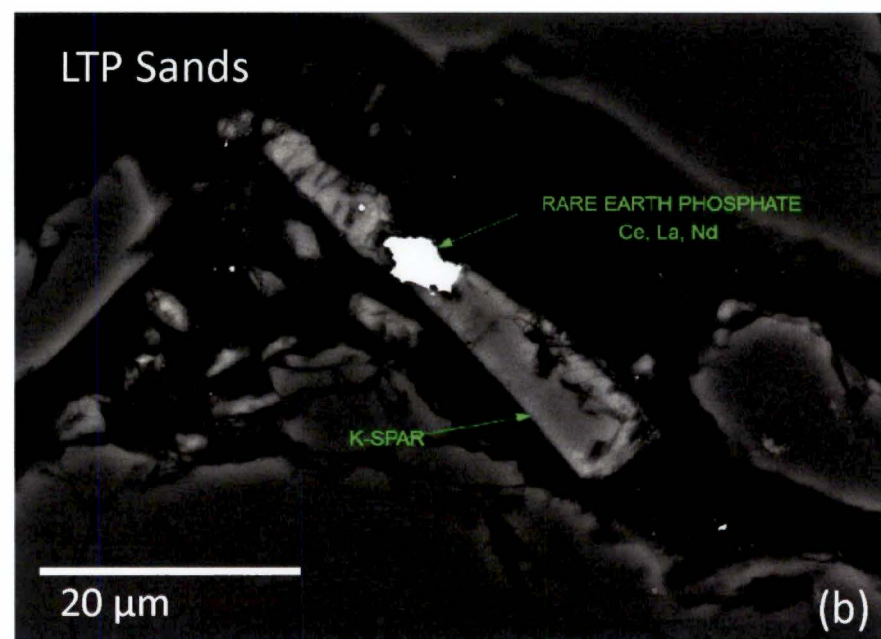
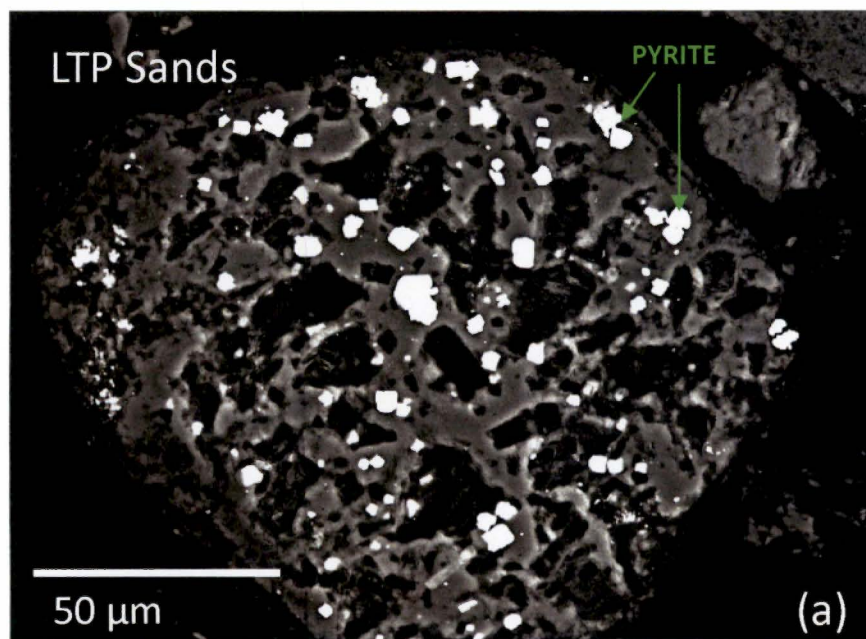


Figure 10. Example Mineralogical Occurrences as Observed Using SEM in the LTP and STP Tailing Solids.

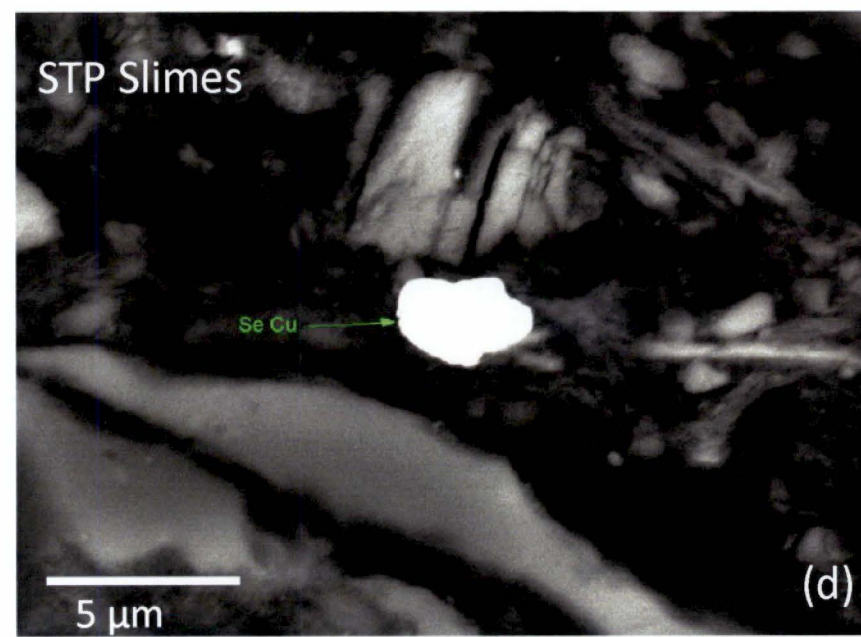
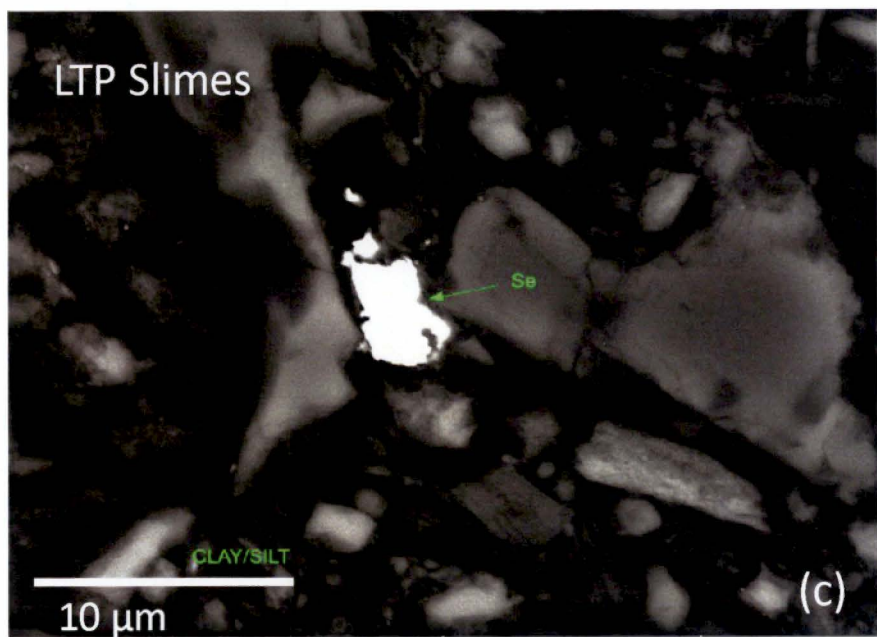
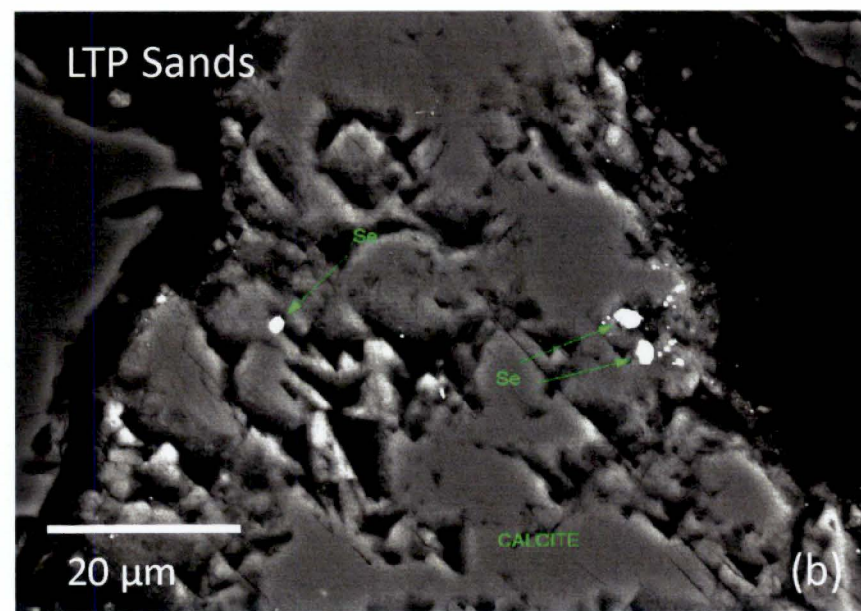
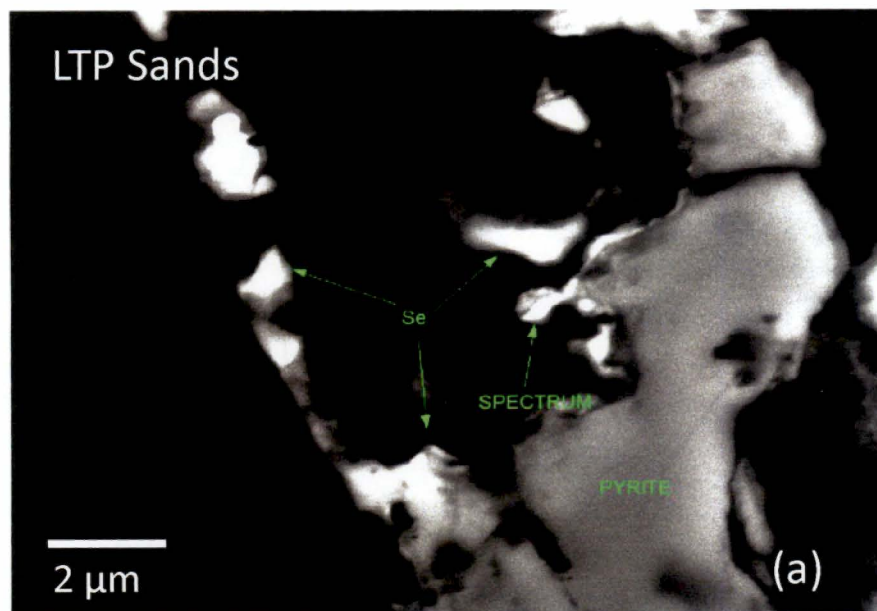


Figure 11. Various Forms of Selenium as Observed Using SEM in the LTP and STP Tailing Solids.

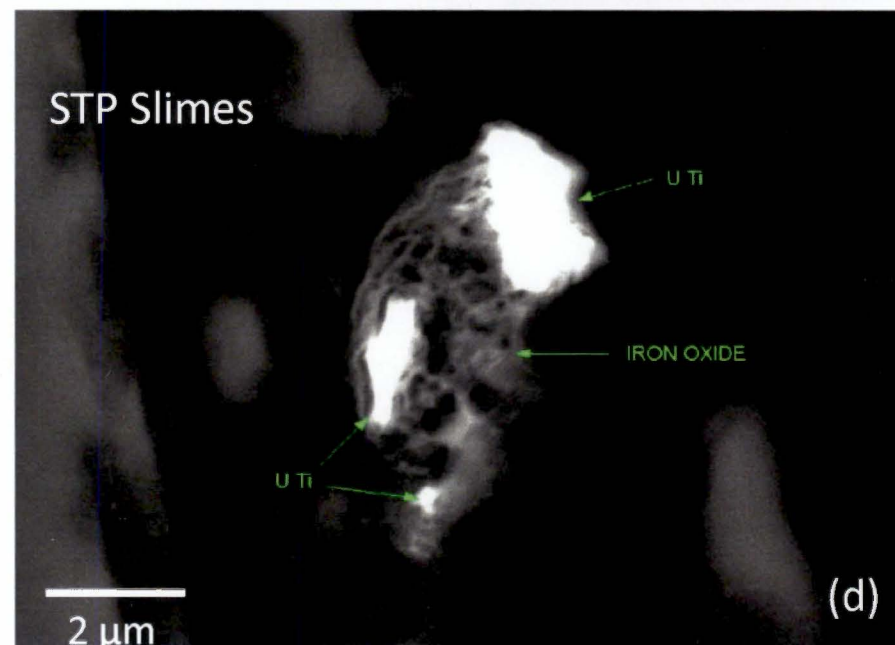
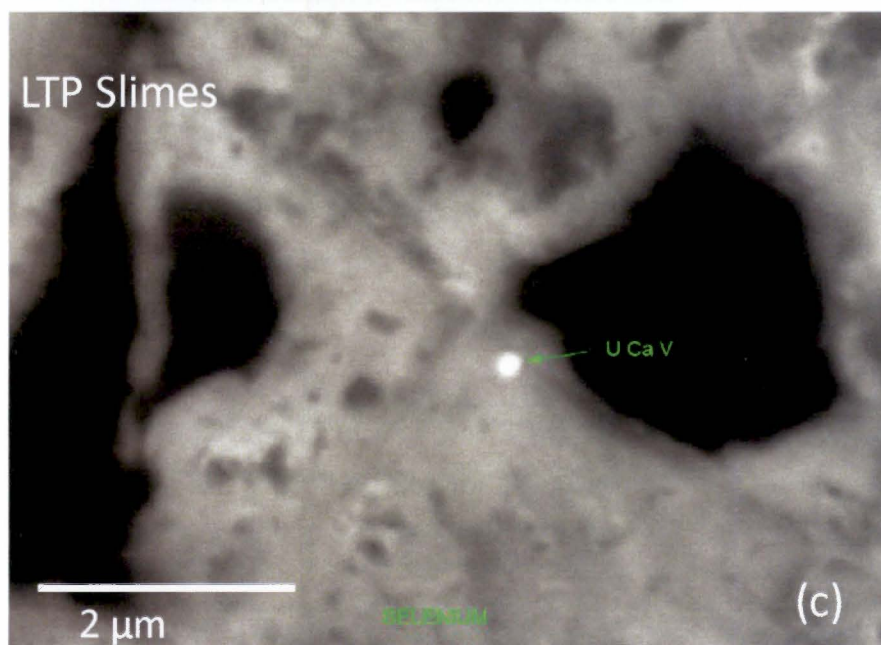
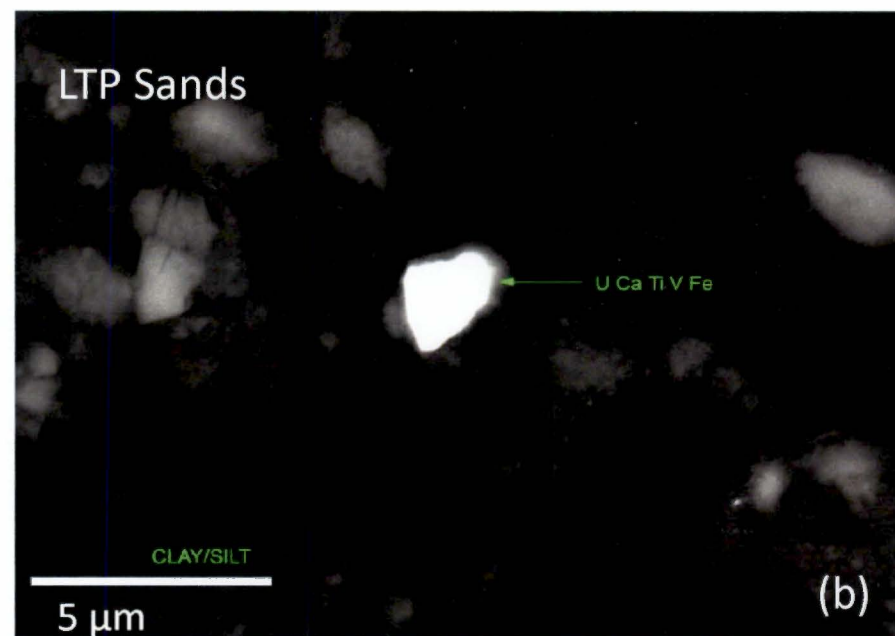
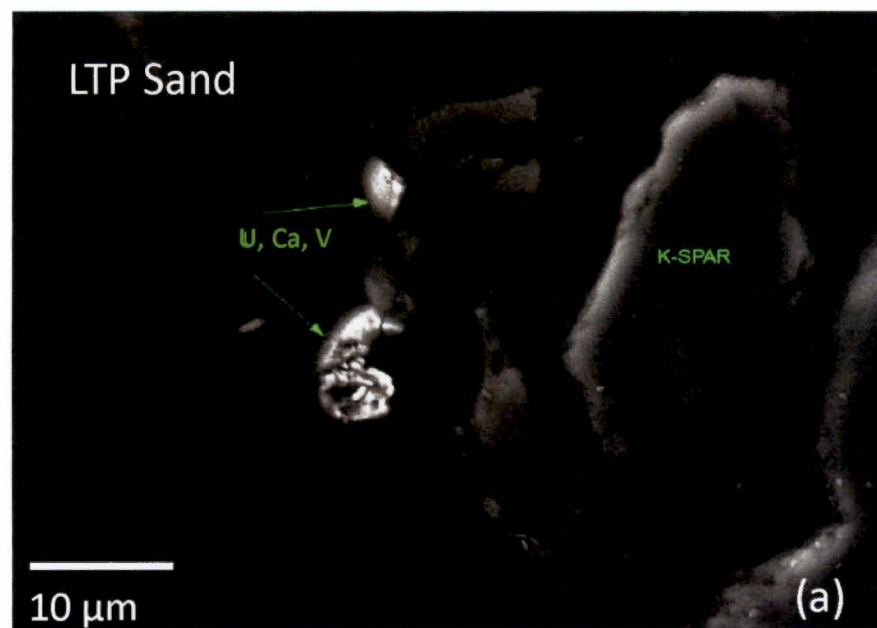


Figure 12. Various Forms of Uranium as Observed Using SEM in the LTP and STP Tailing Solids.

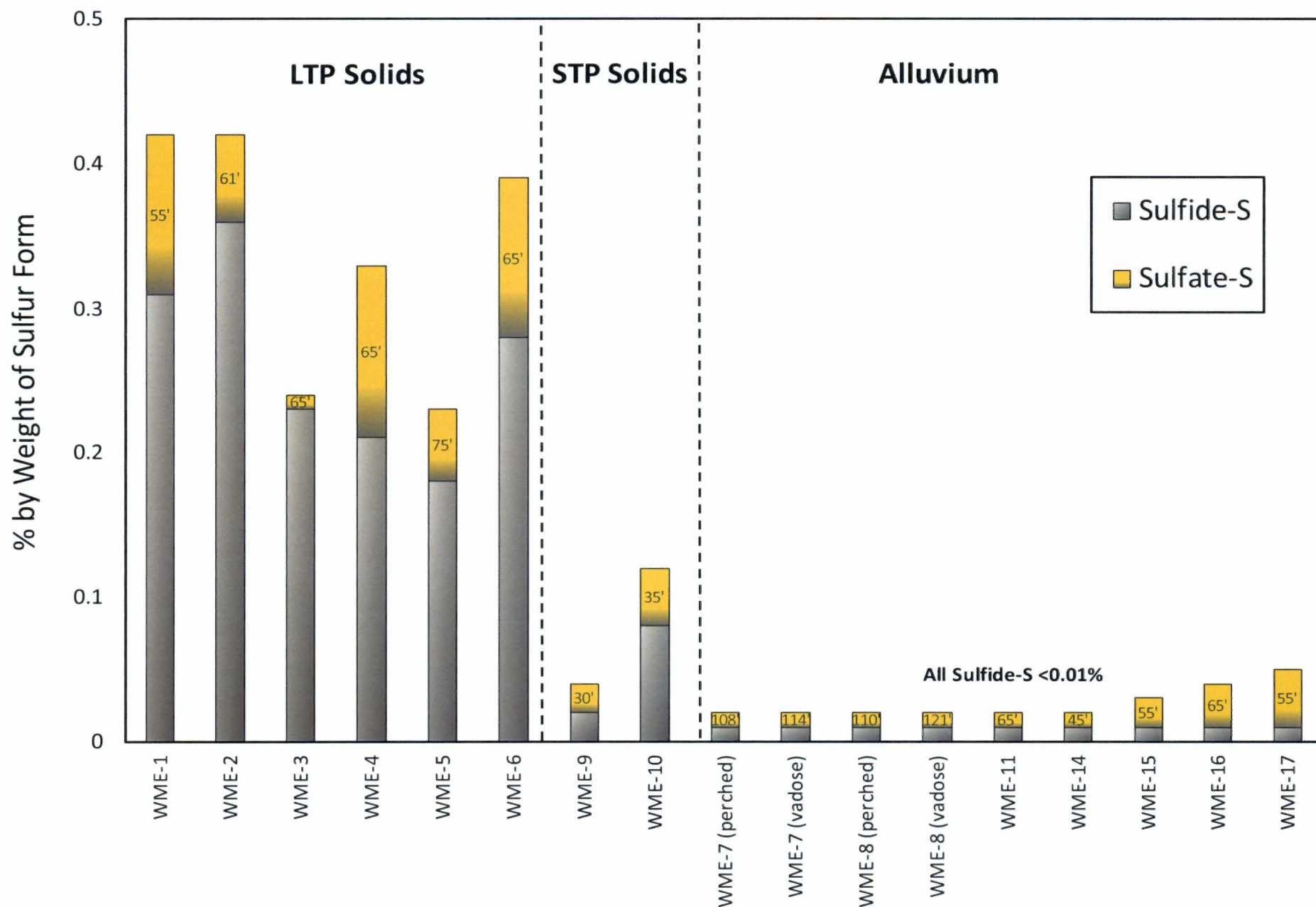


Figure 13. Acid-Base Accounting Results for Sulfur Forms in Tailings and Alluvium.

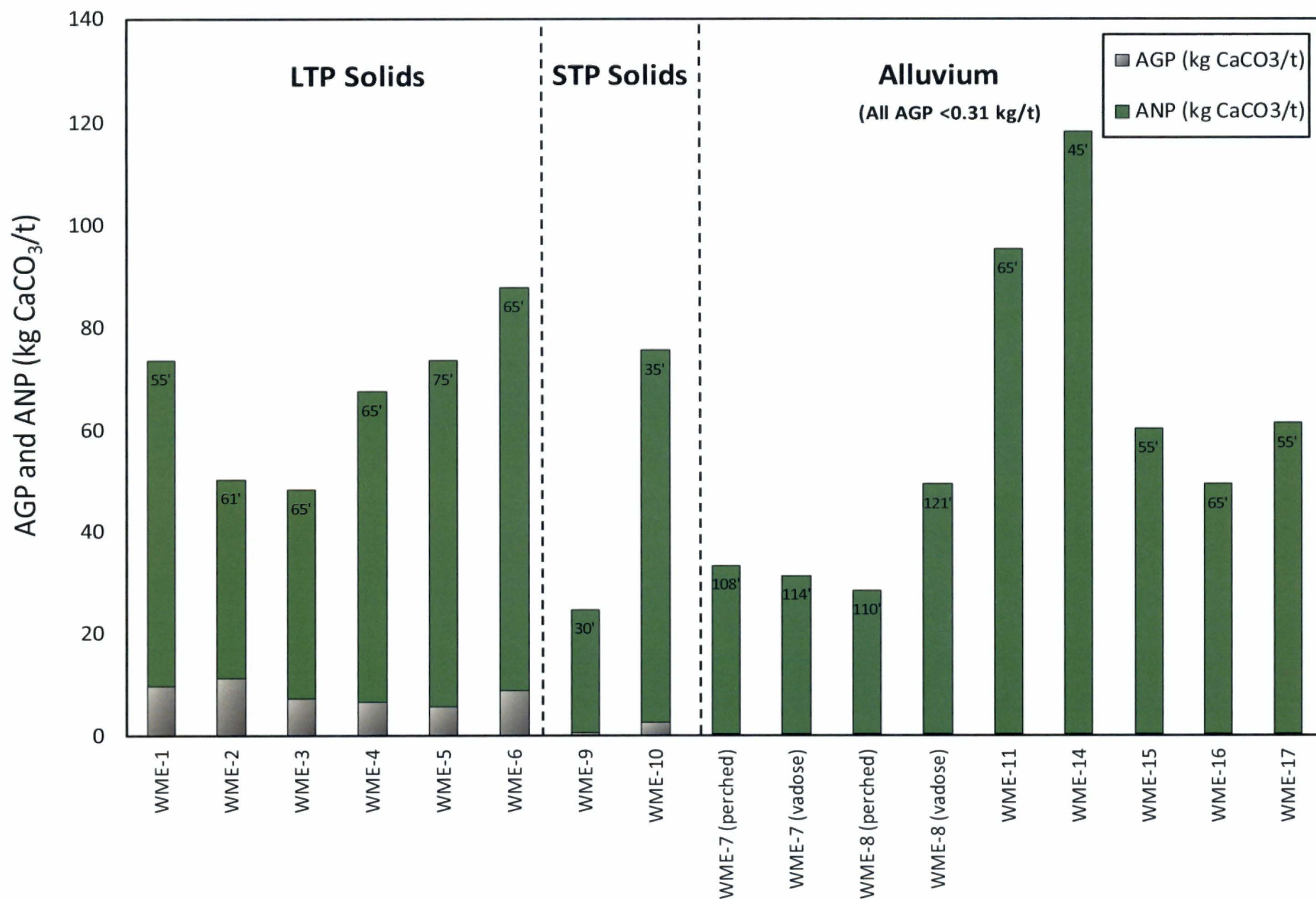


Figure 14. Acid-Base Accounting Results for AGP and ANP in Tailings and Alluvium.

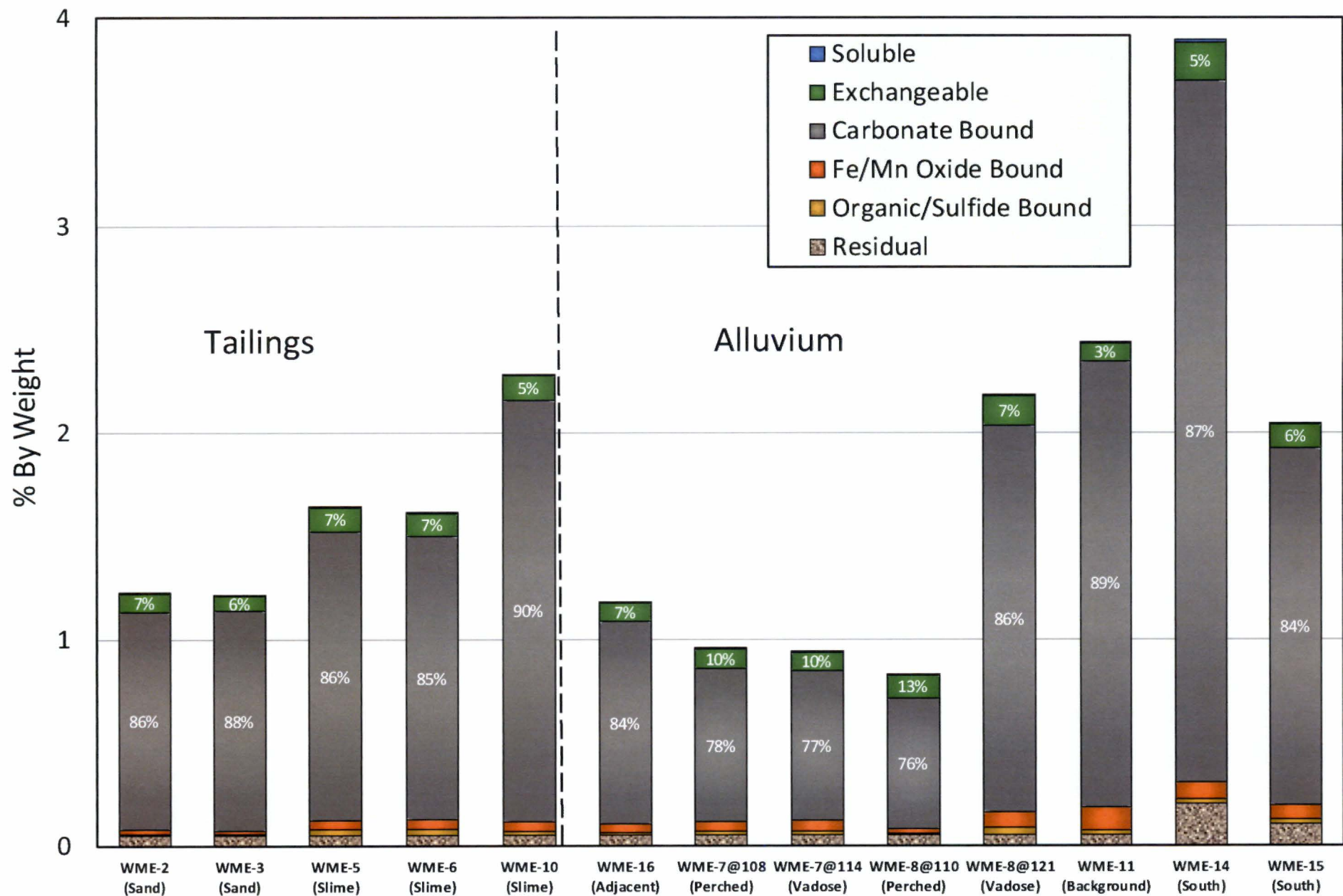


Figure 15. Selective Extraction Results for Calcium Fractionation in Tailings and Alluvium.

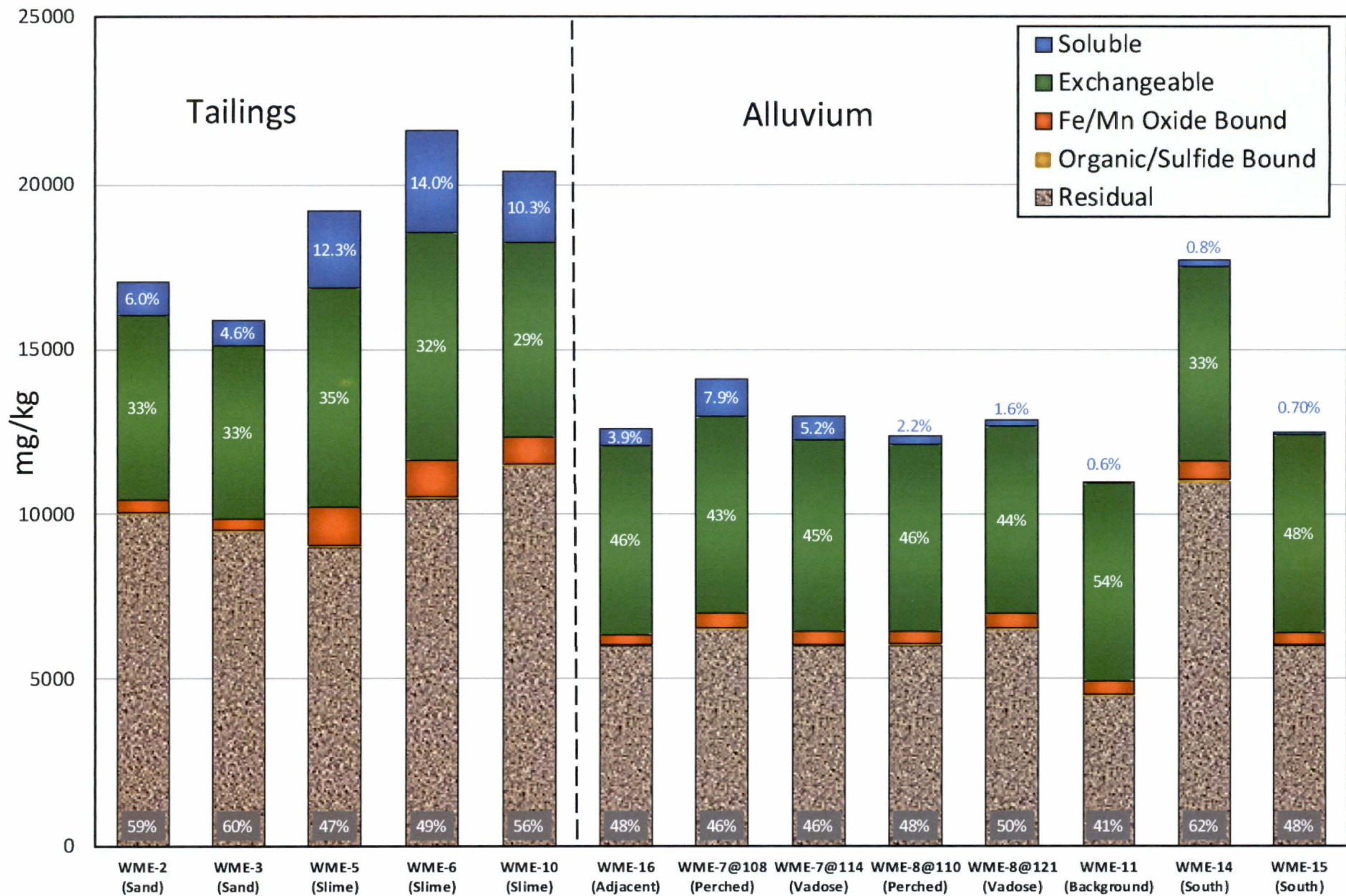


Figure 16. Selective Extraction Results for Sodium Fractionation in Tailings and Alluvium.

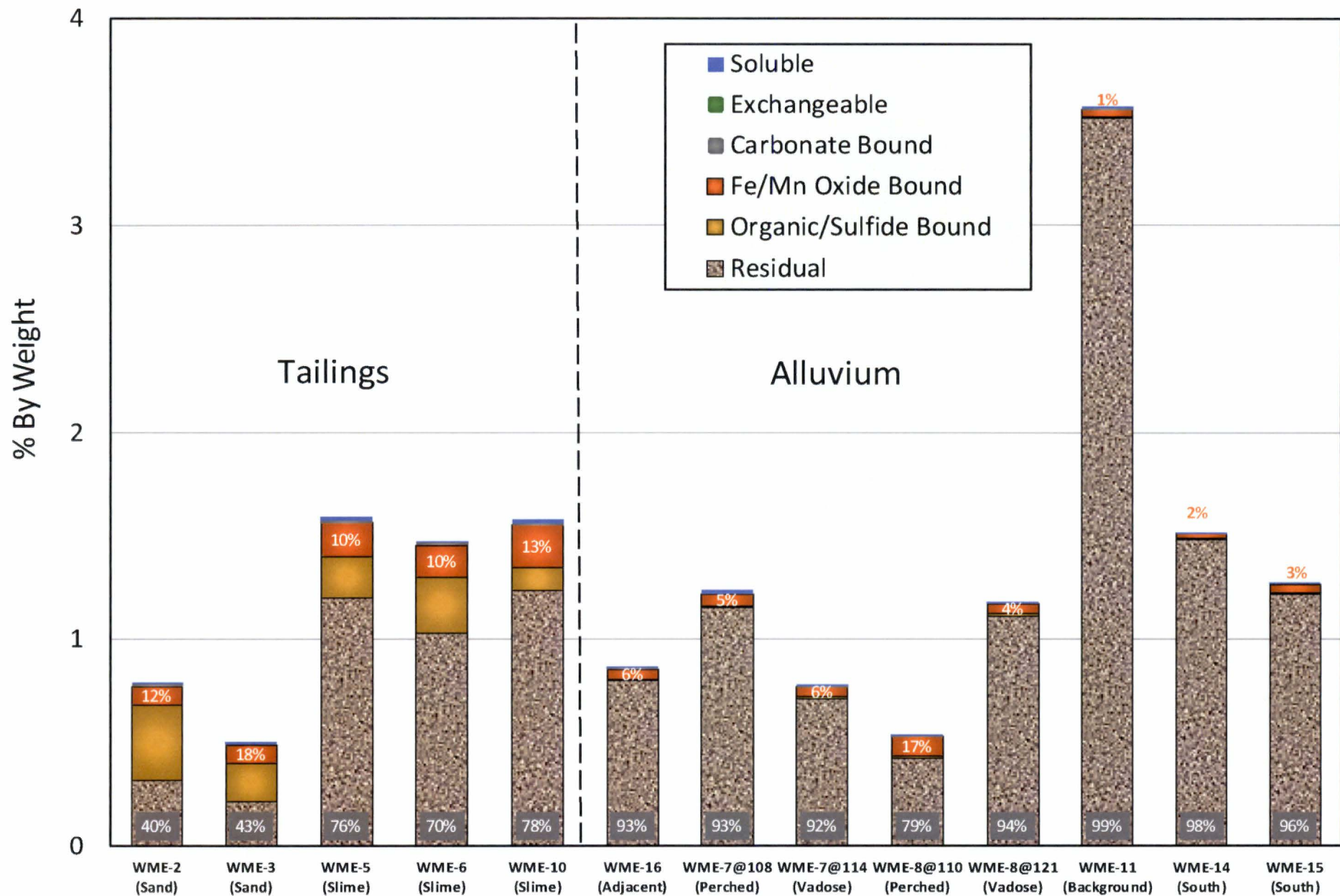


Figure 17. Selective Extraction Results for Iron Fractionation in Tailings and Alluvium.

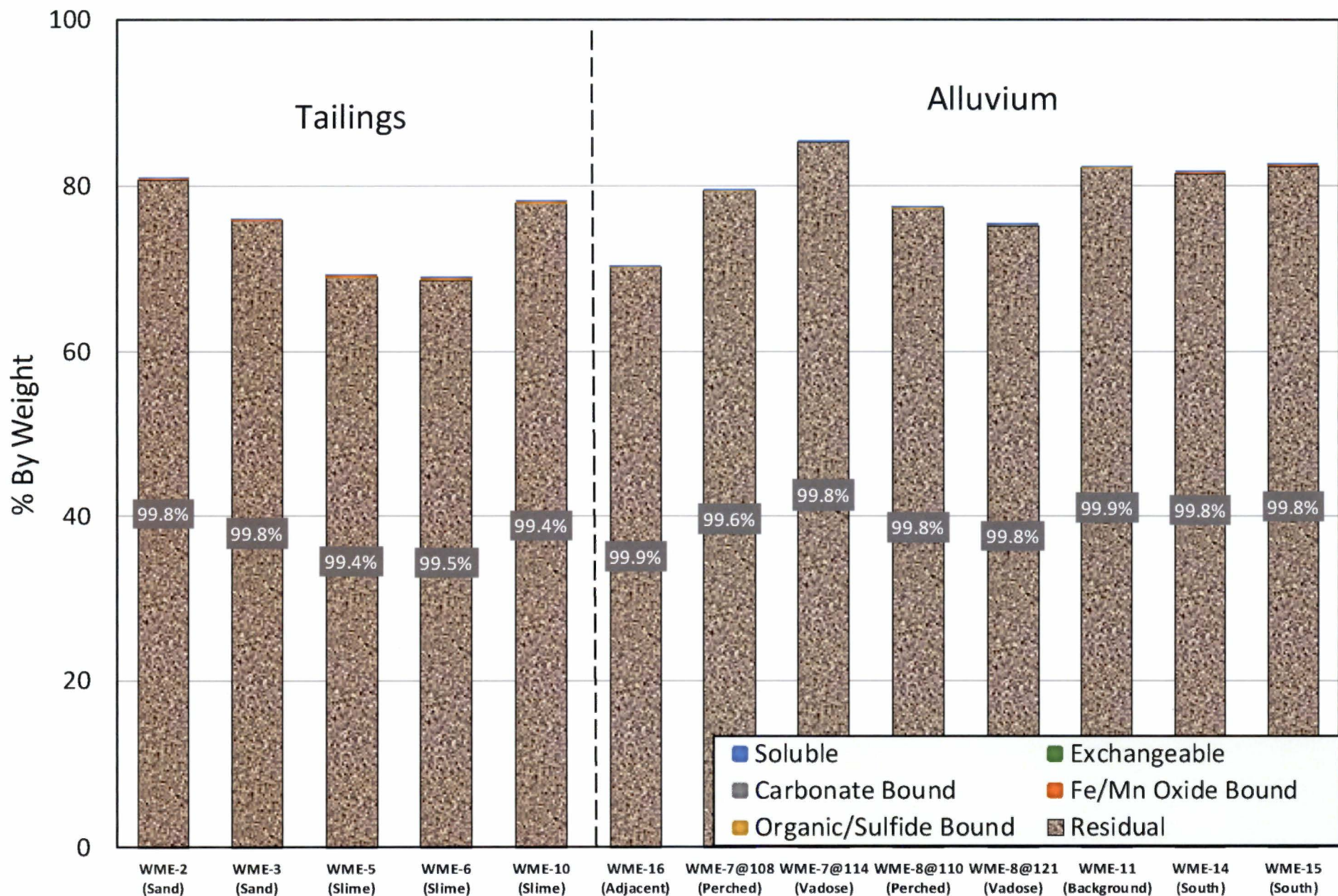


Figure 18. Selective Extraction Results for Silica Fractionation in Tailings and Alluvium.

Uranium Fractionation - Tailings

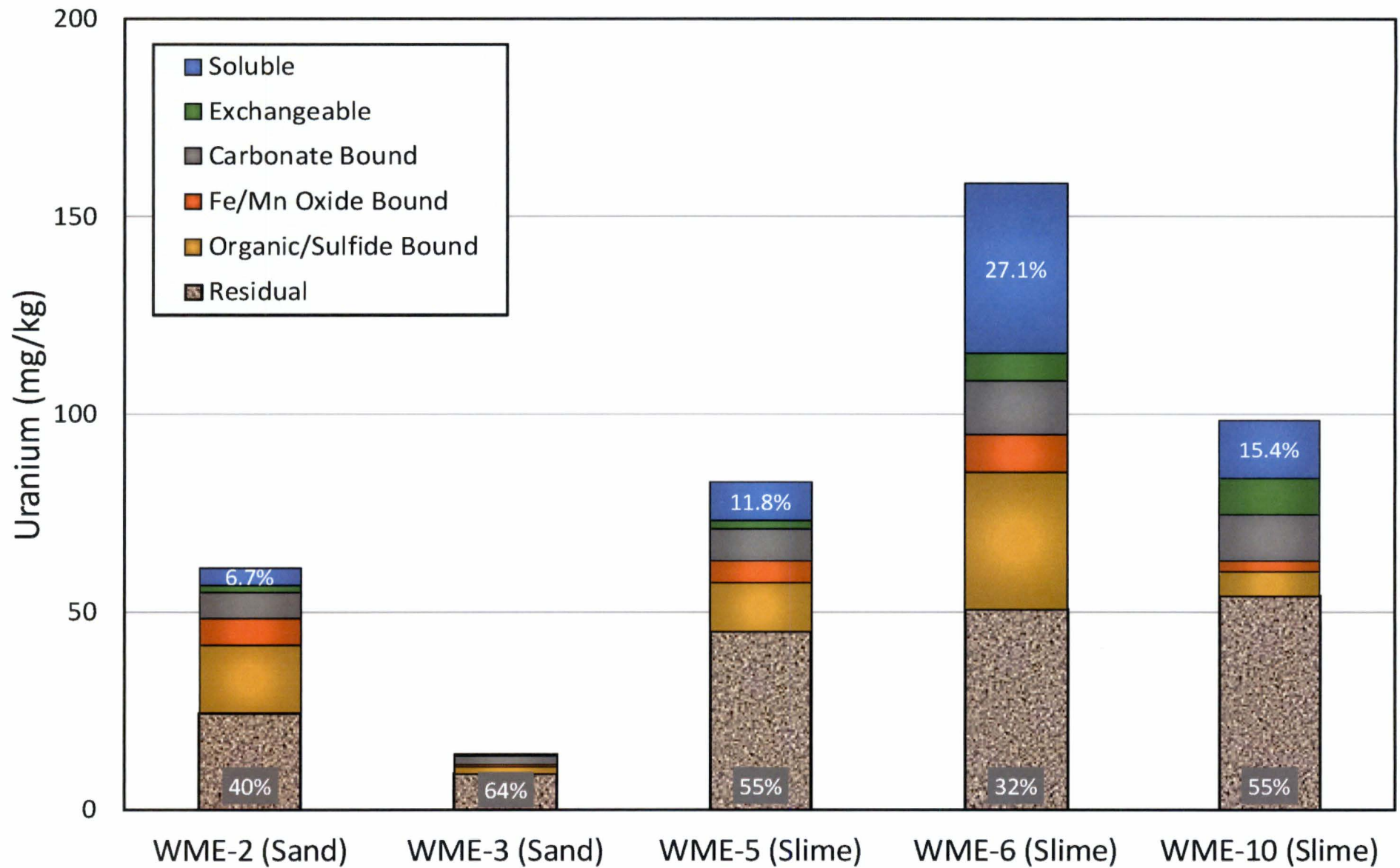


Figure 19. Selective Extraction Results for Uranium in Tailings.

Molybdenum Fractionation - Tailings

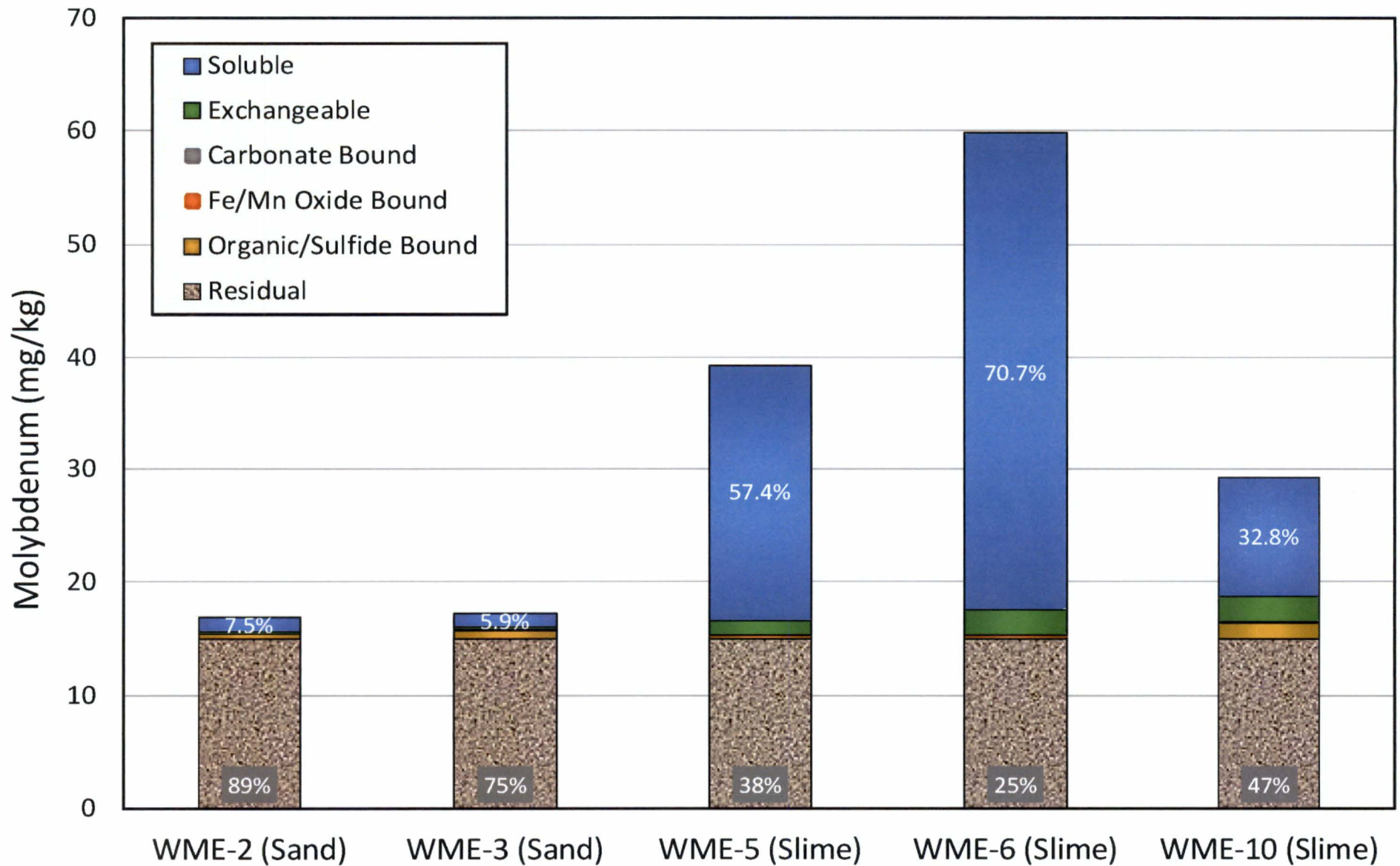


Figure 20. Selective Extraction Results for Molybdenum in Tailings.

Selenium Fractionation - Tailings

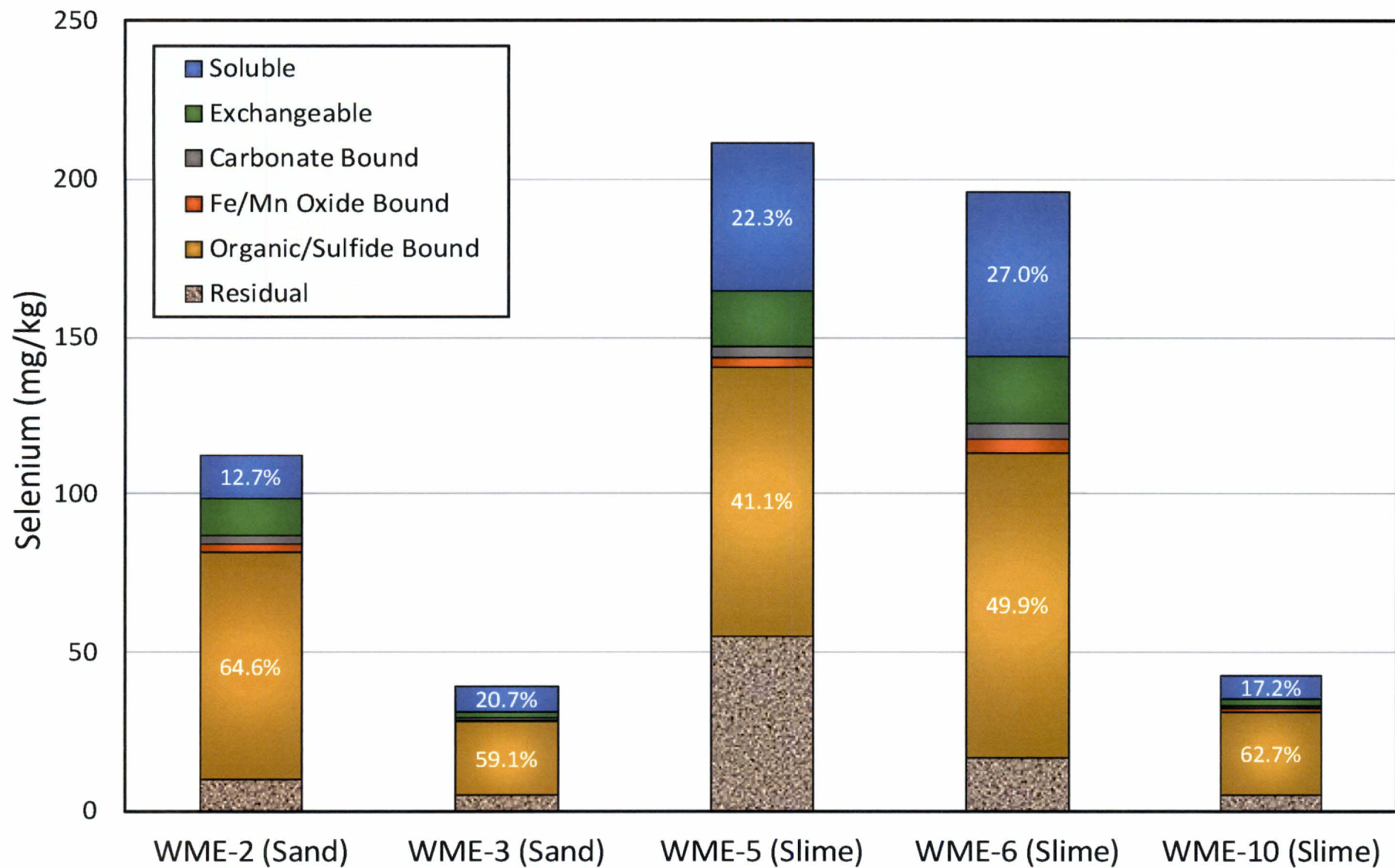


Figure 21. Selective Extraction Results for Selenium in Tailings.

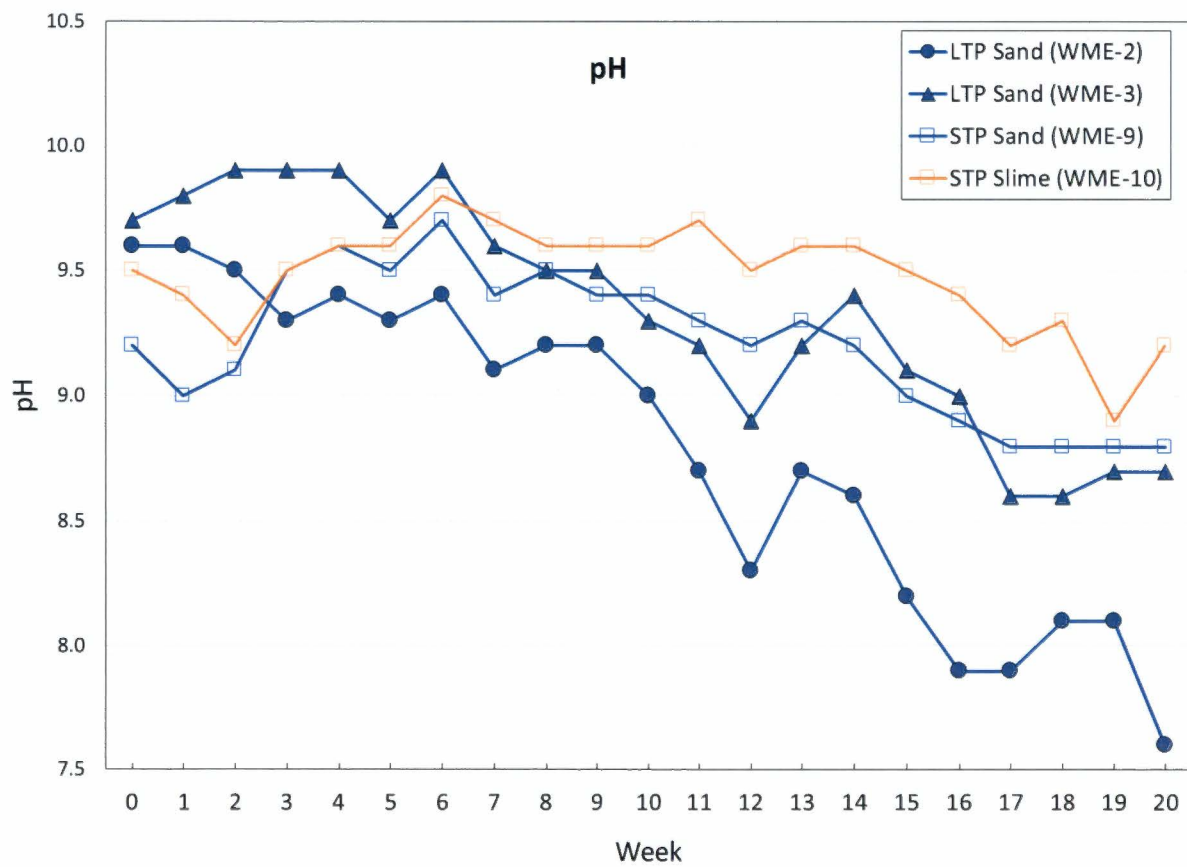
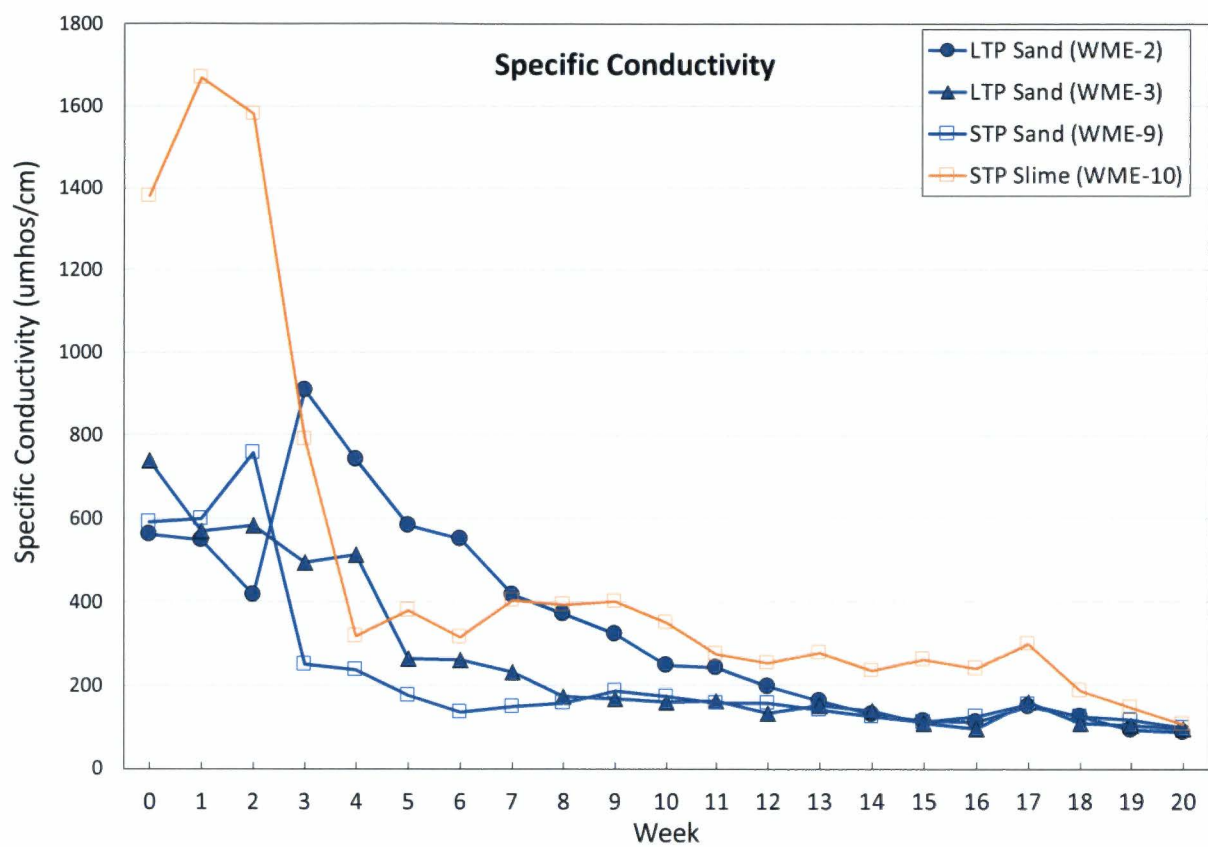


Figure 22. LTP Humidity Cell Test Results for Specific Conductivity and pH.

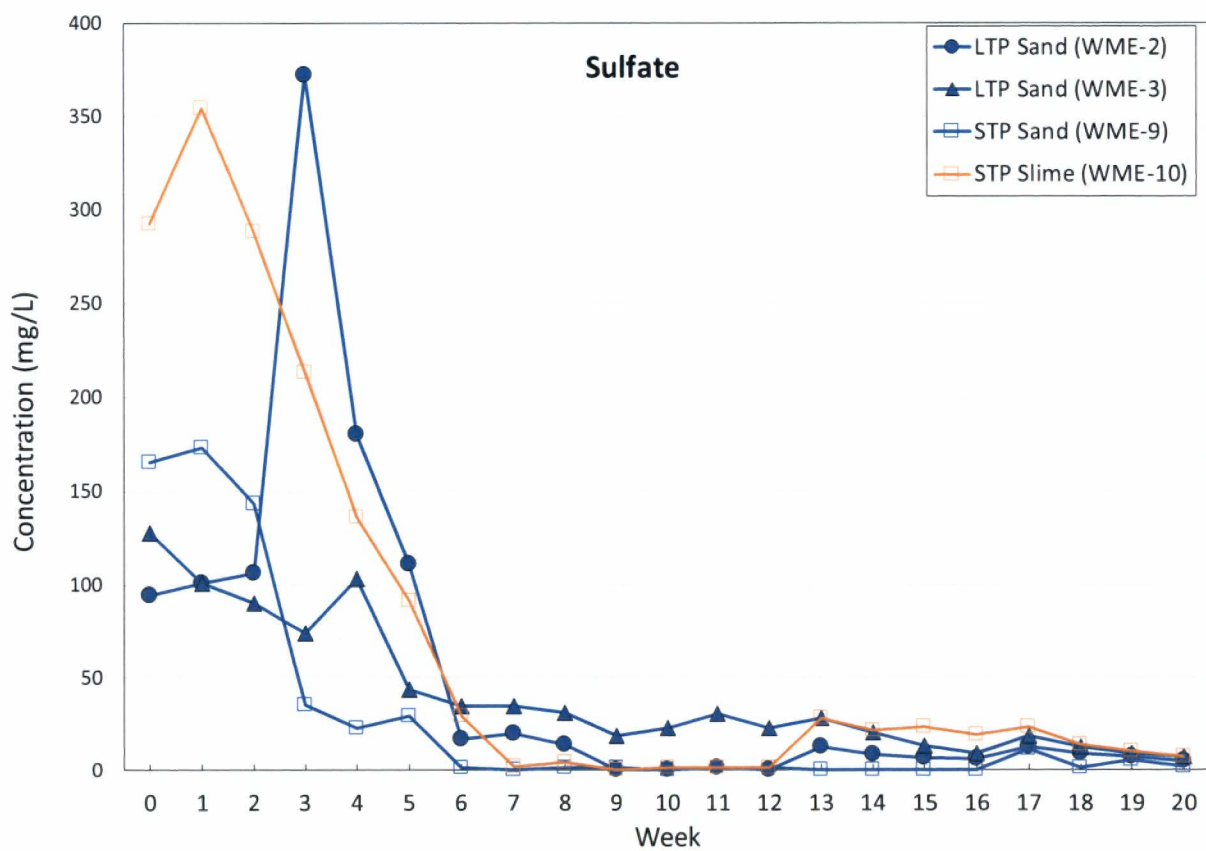
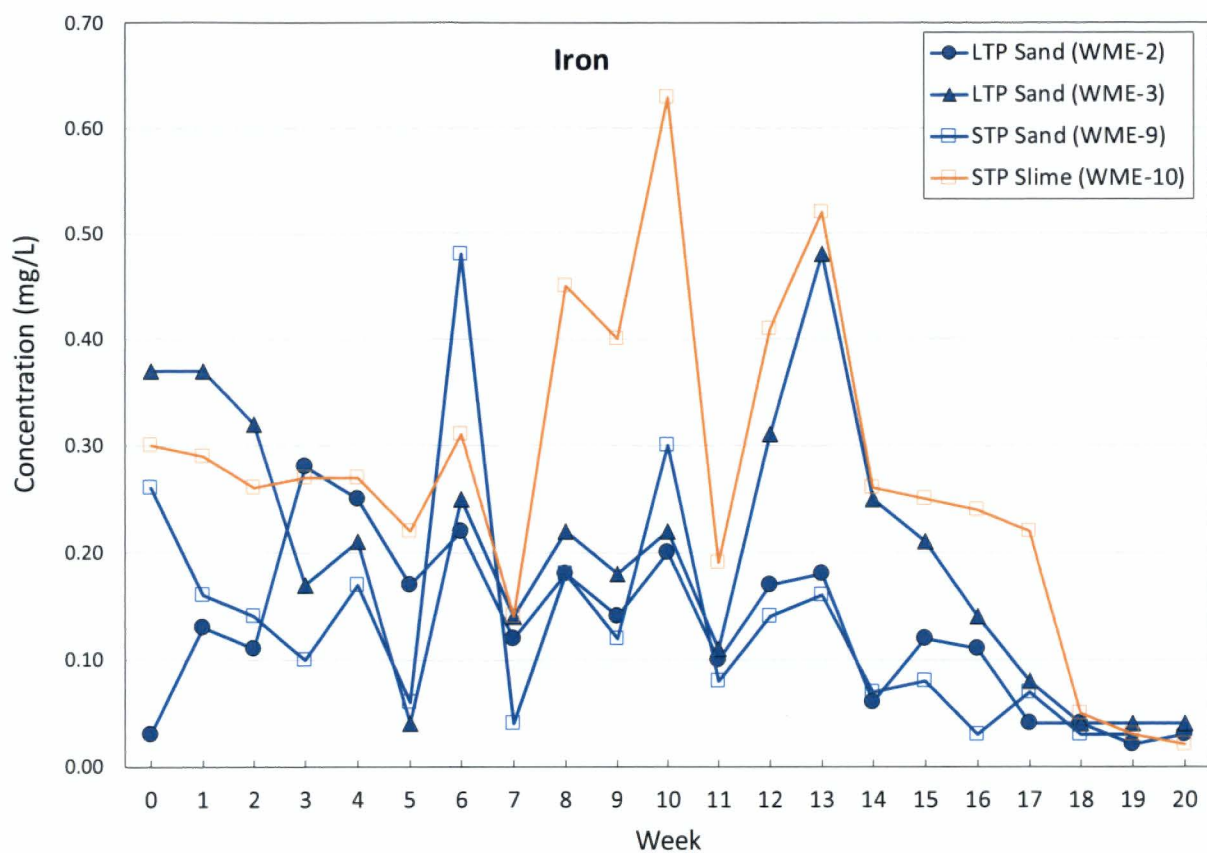


Figure 23. LTP Humidity Cell Test Results for Iron and Sulfate.

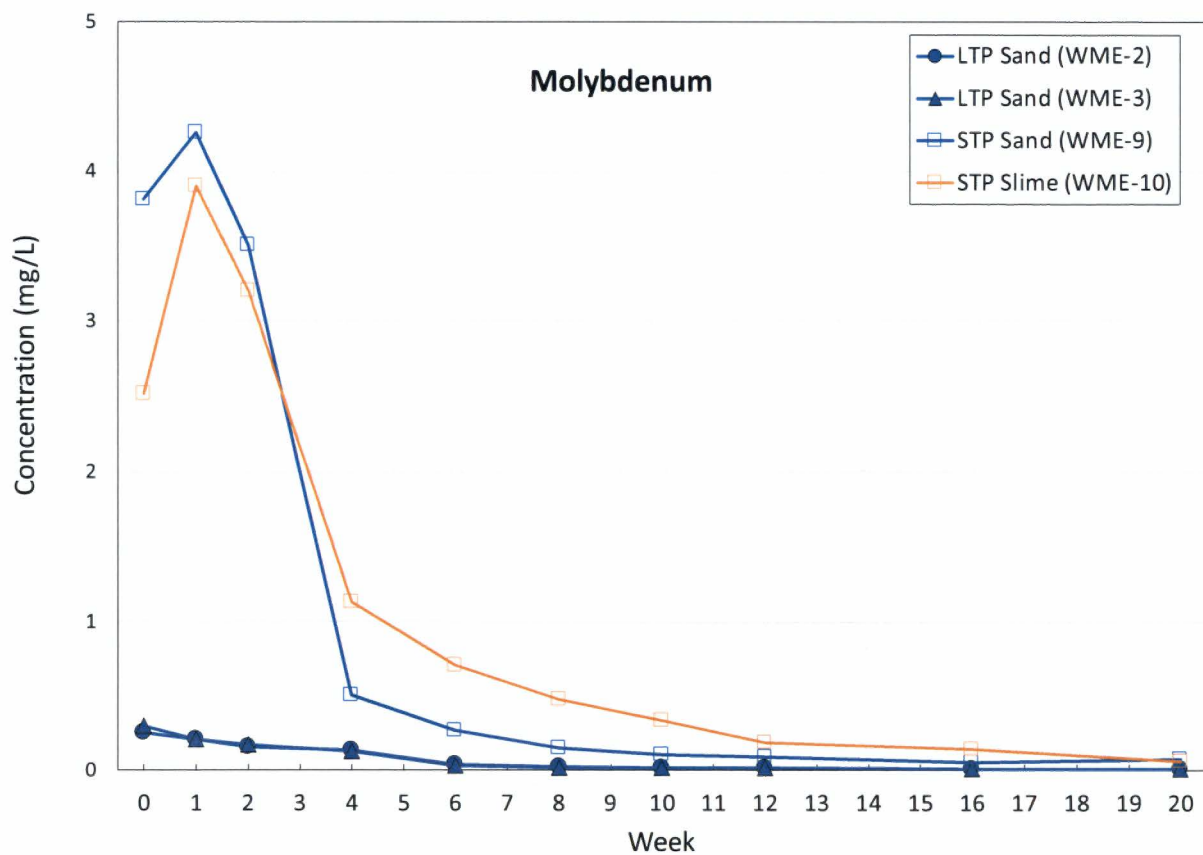
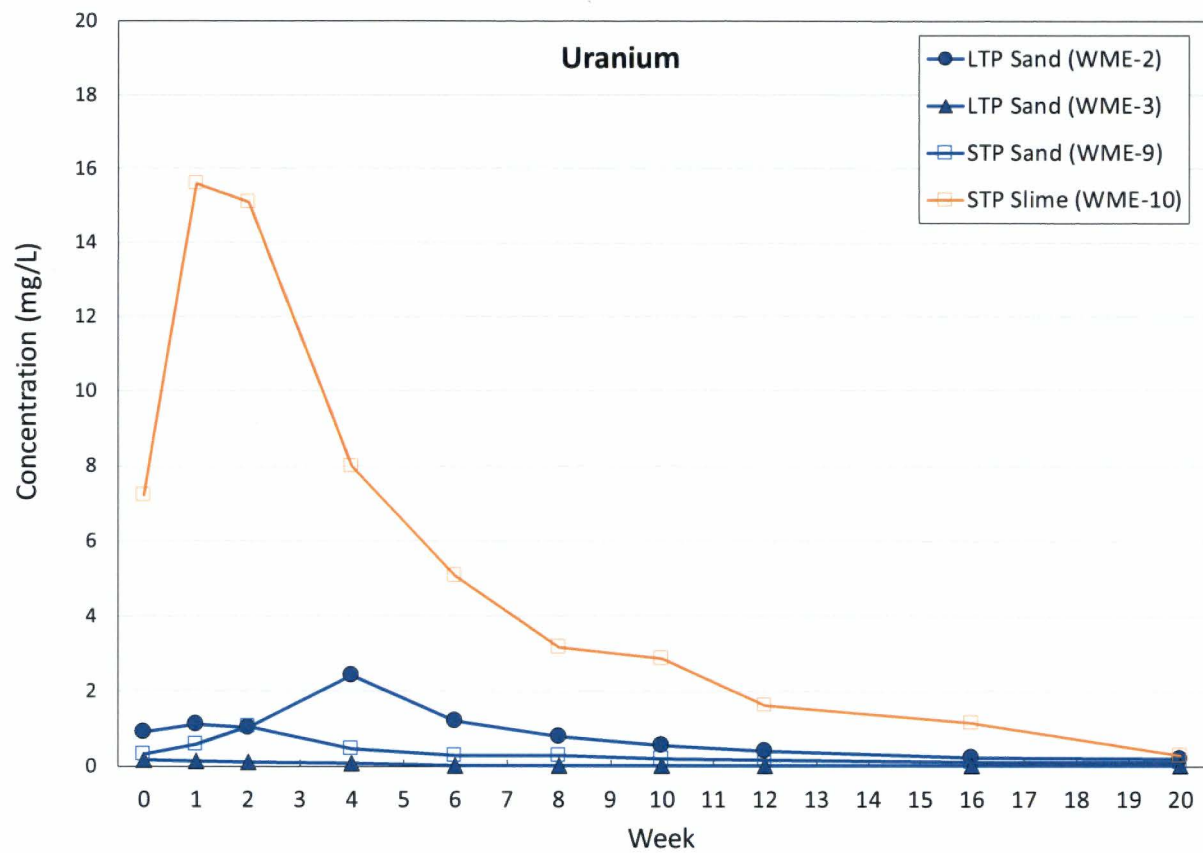


Figure 24. LTP Humidity Cell Test Results for Uranium and Molybdenum.

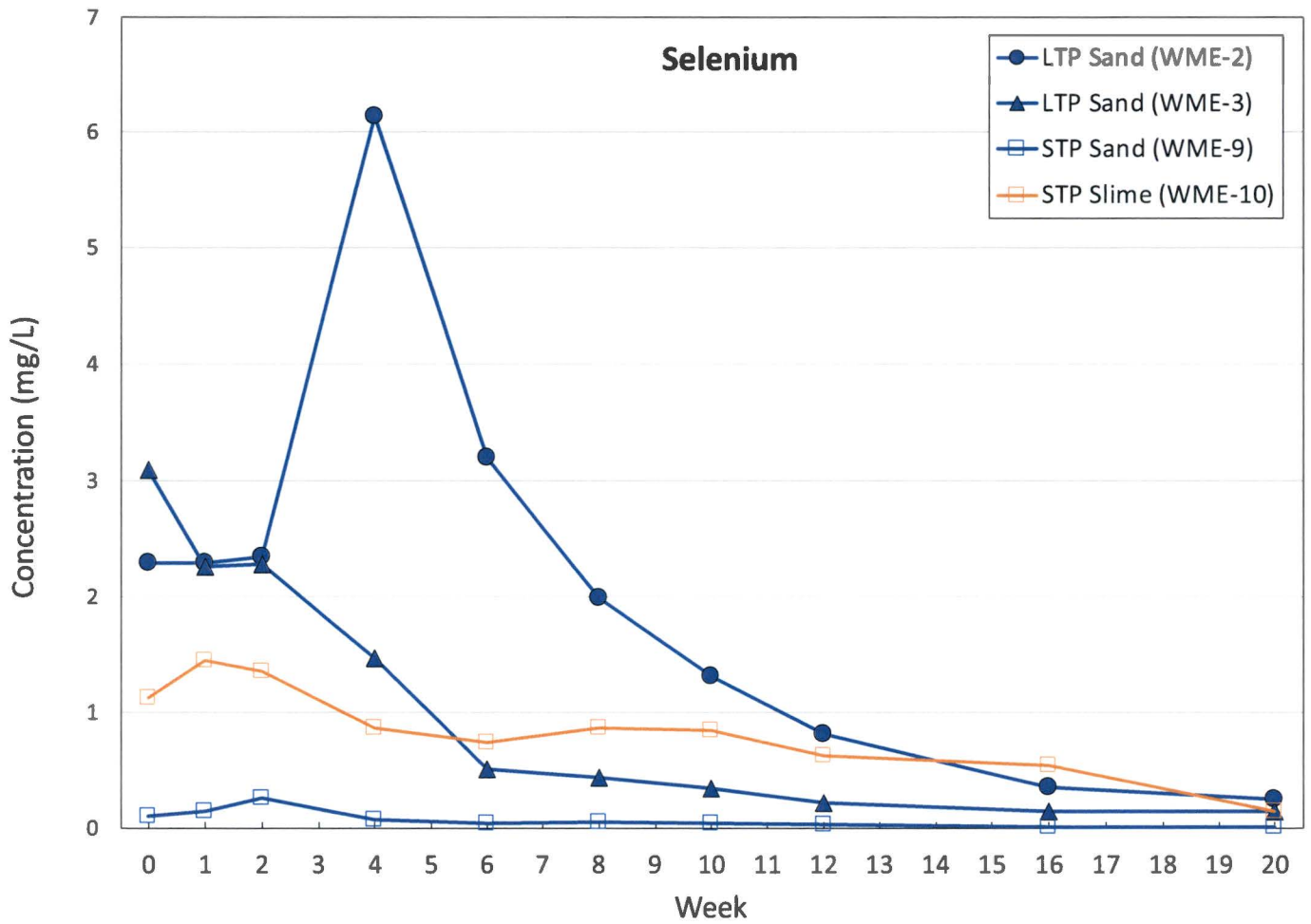


Figure 25. LTP Humidity Cell Test Results for Selenium.

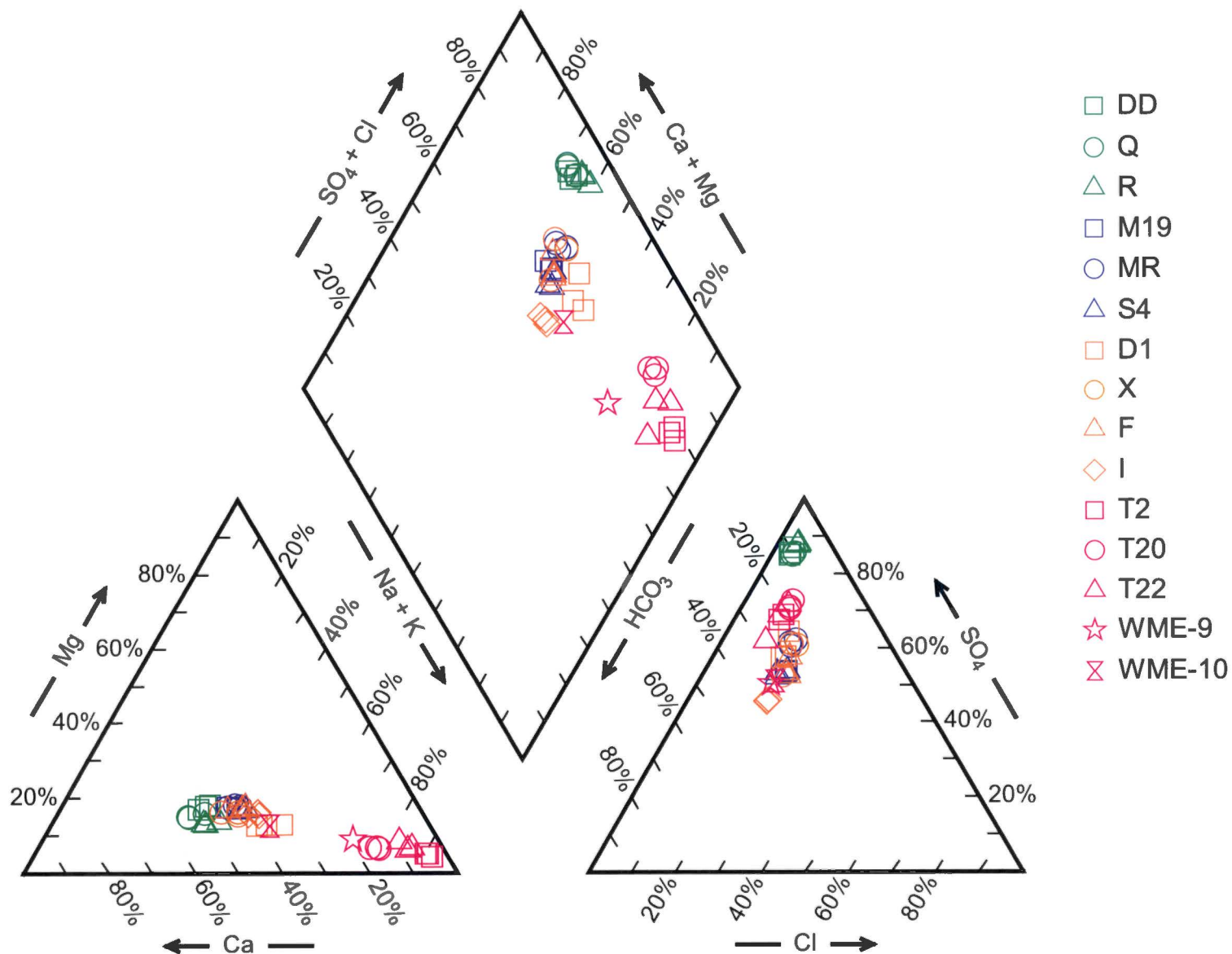


Figure 26. Trilinear Diagram for Alluvial Wells (2018).

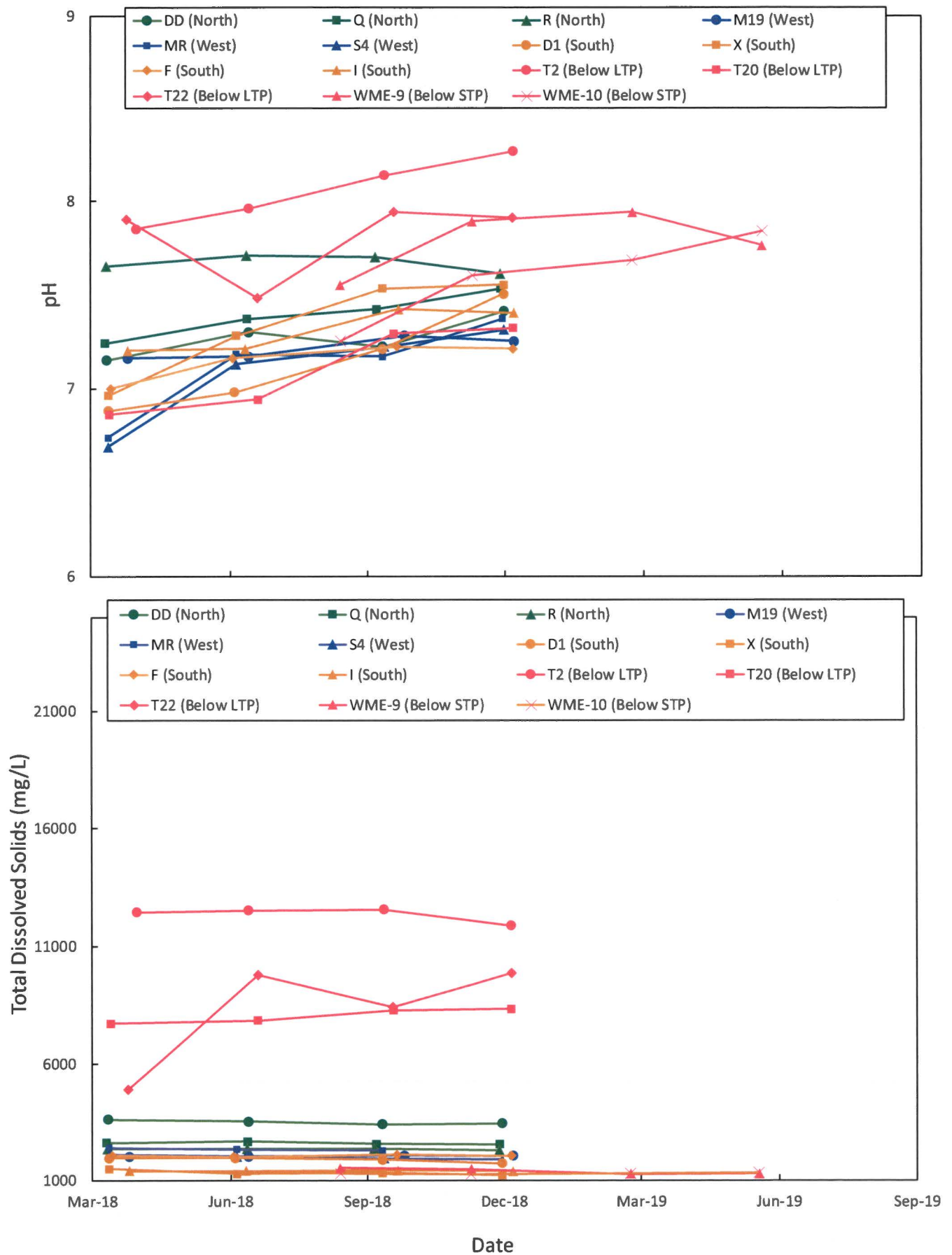


Figure 27. pH and Total Dissolved Solids for the Alluvial Wells Studied.

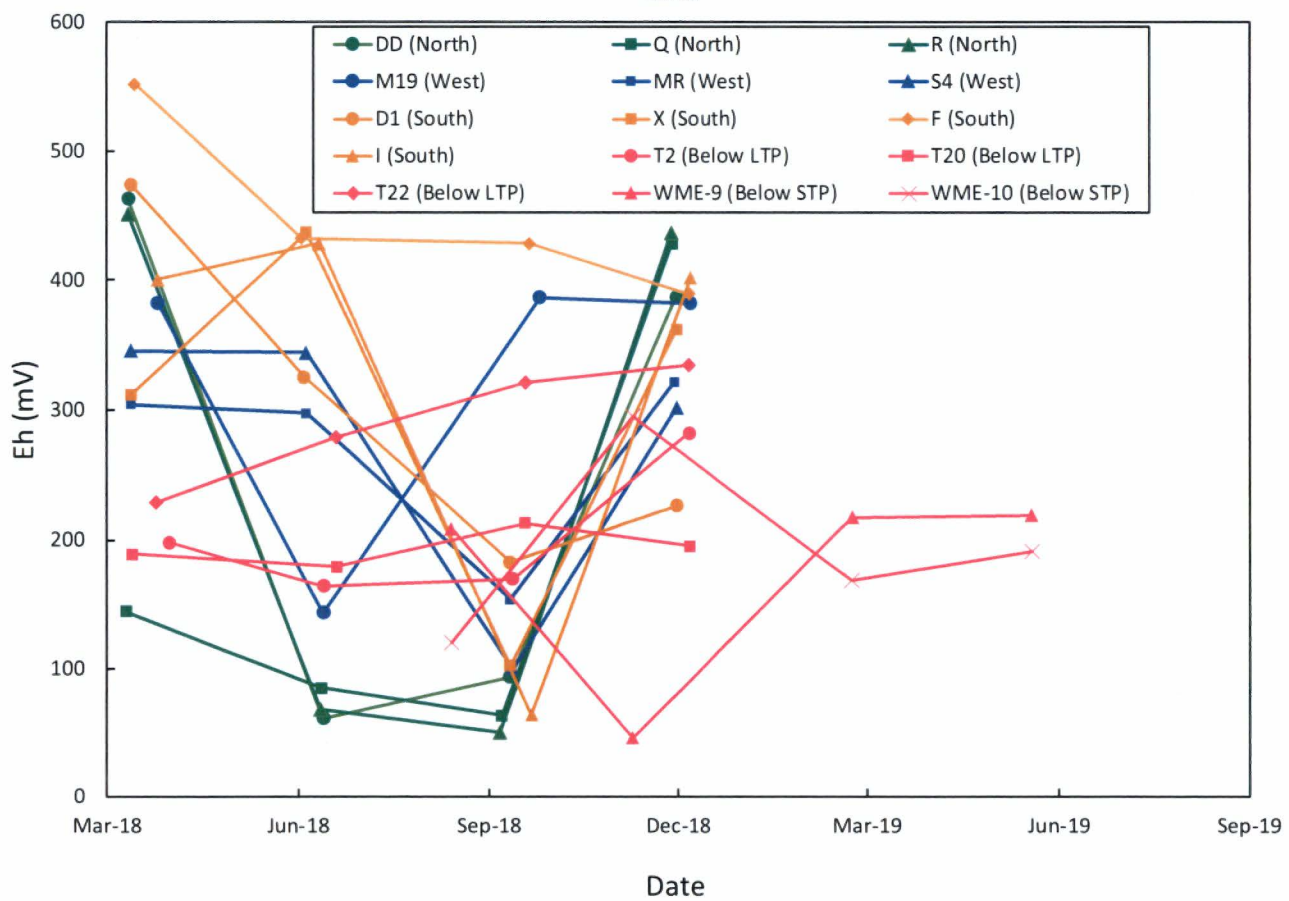
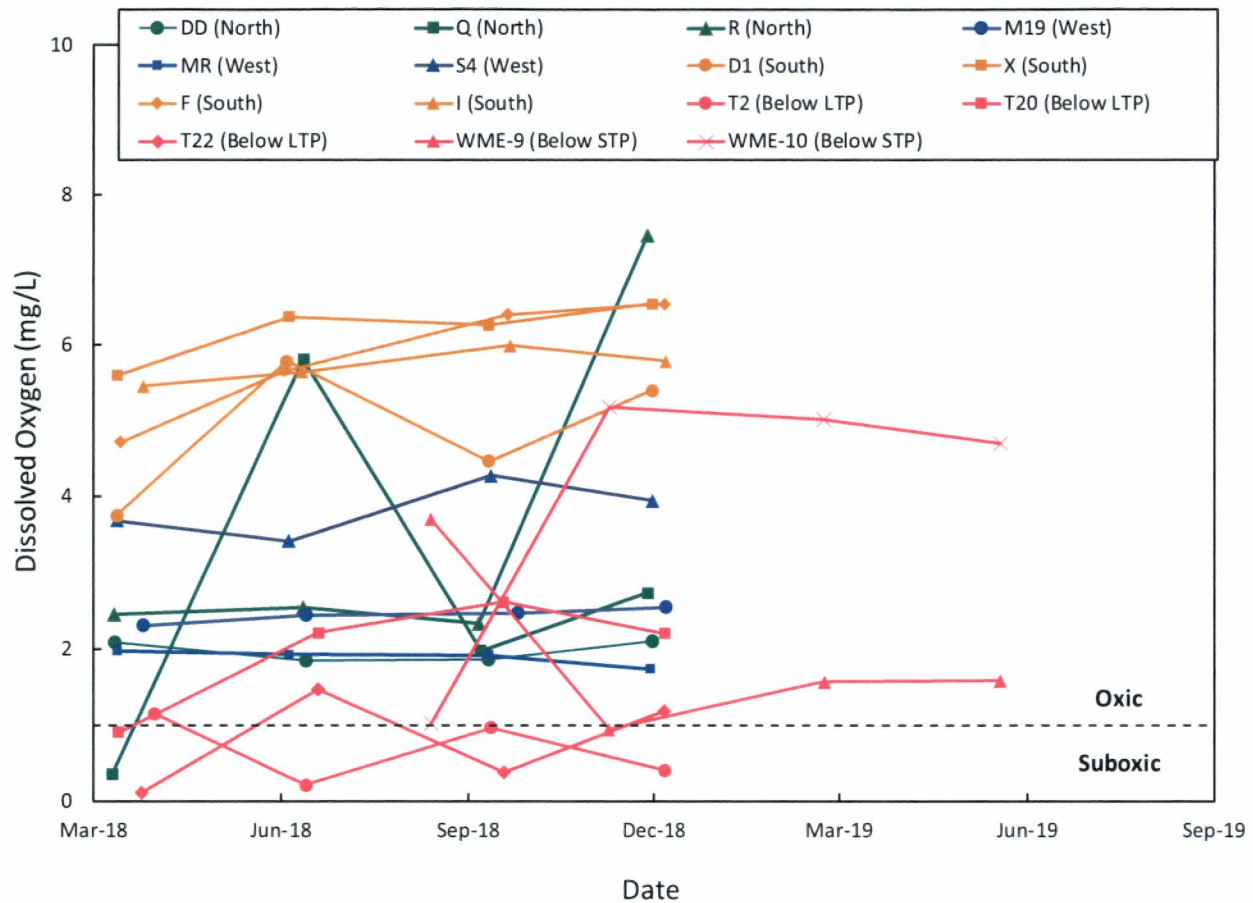


Figure 28. Dissolved Oxygen and Calculated Eh for the Alluvial Wells Studied.

Uranium Fractionation - Alluvium

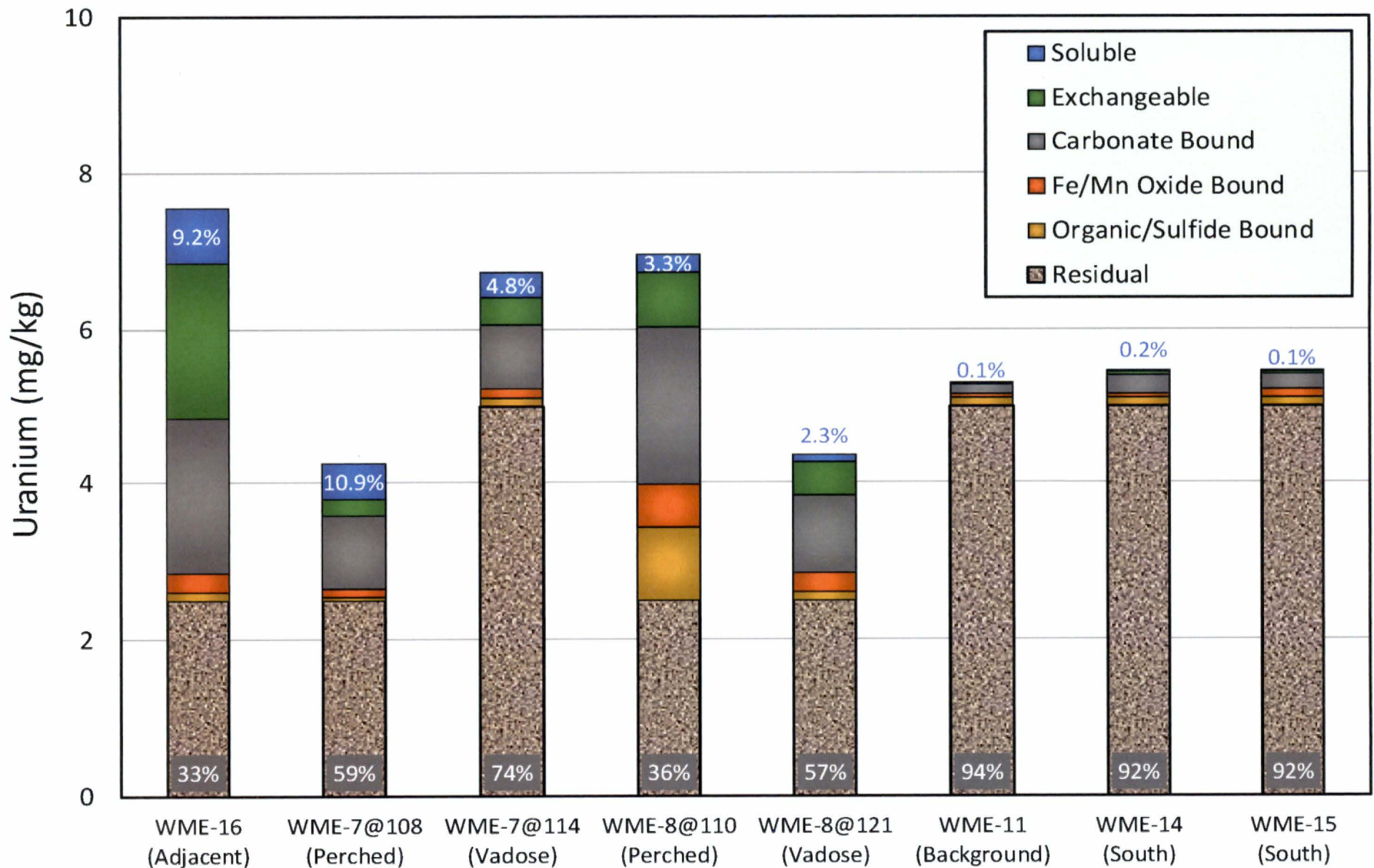


Figure 29. Selective Extraction Results for Uranium in Alluvium.

Molybdenum Fractionation - Alluvium

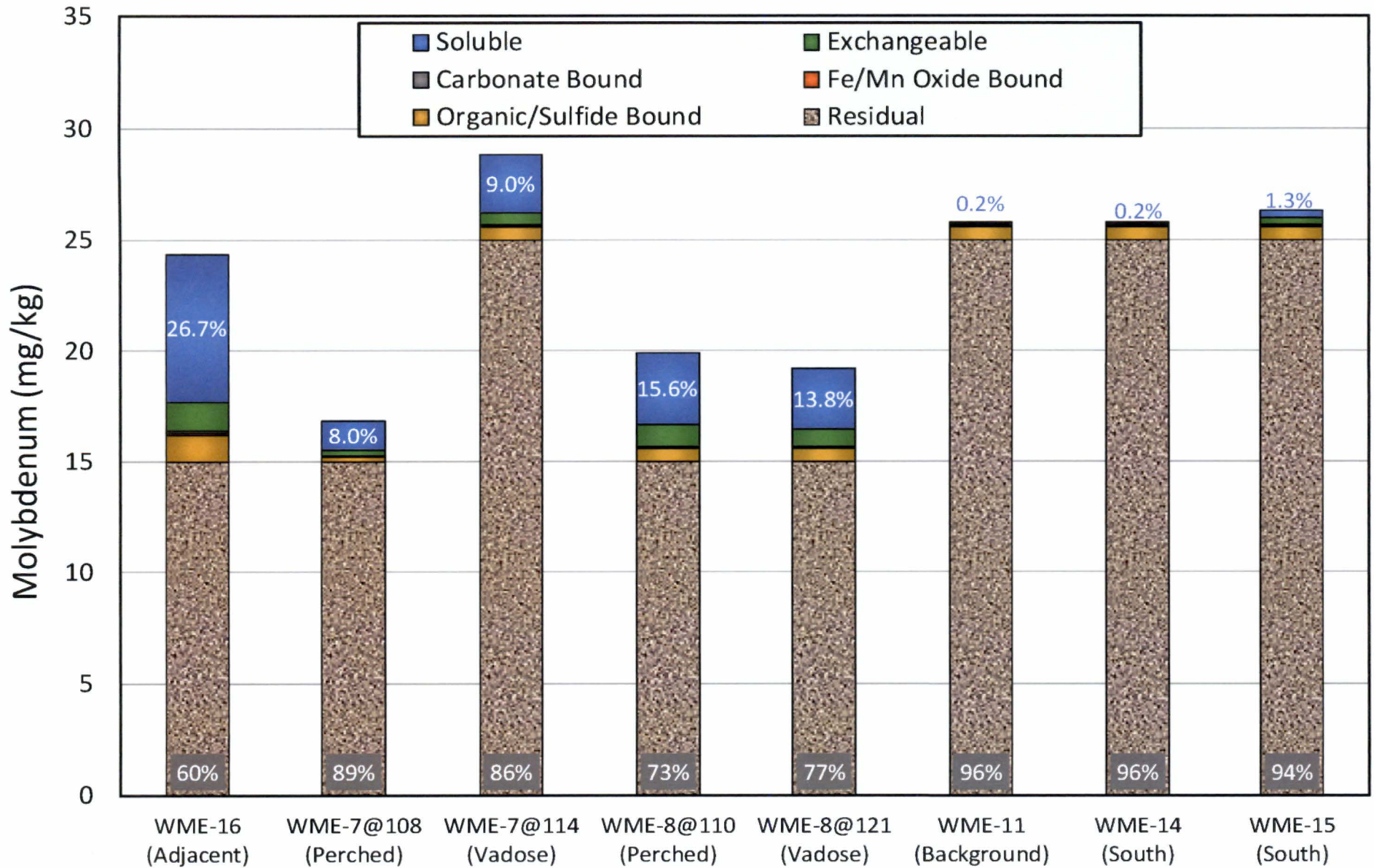


Figure 30. Selective Extraction Results for Molybdenum in Alluvium.

Selenium Fractionation - Alluvium

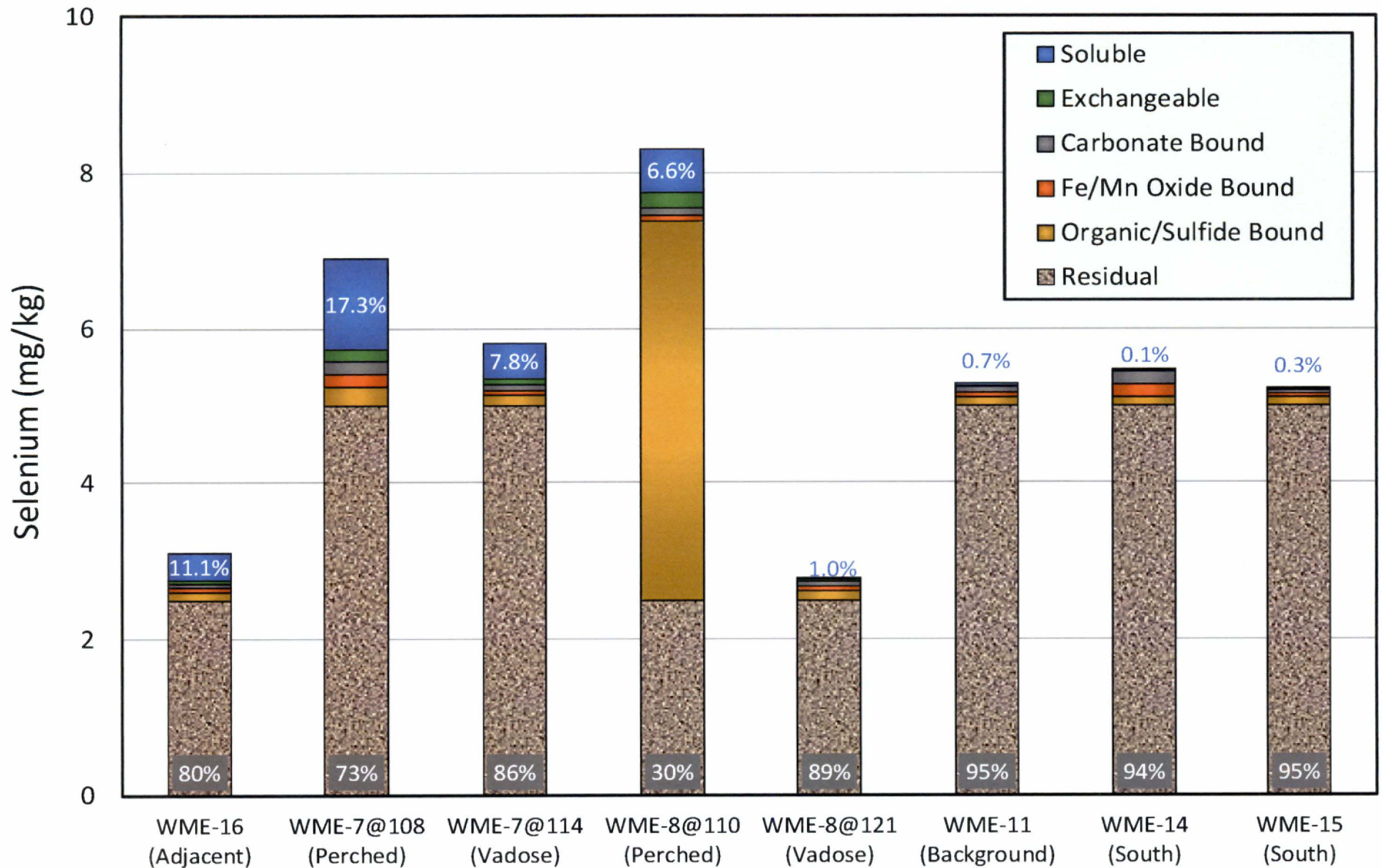


Figure 31. Selective Extraction Results for Selenium in Alluvium.

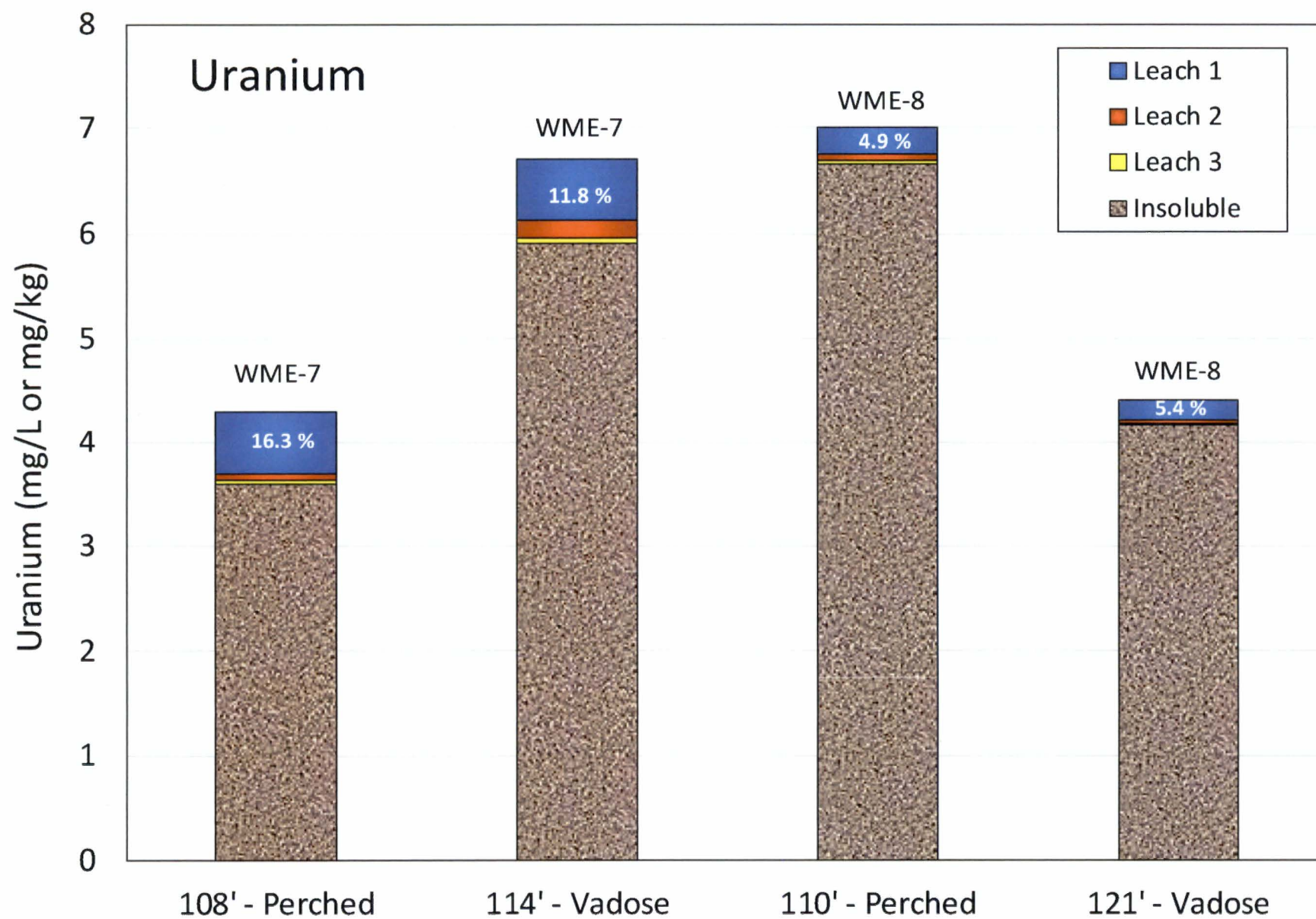


Figure 32. MWMP Results for Uranium in Alluvium.

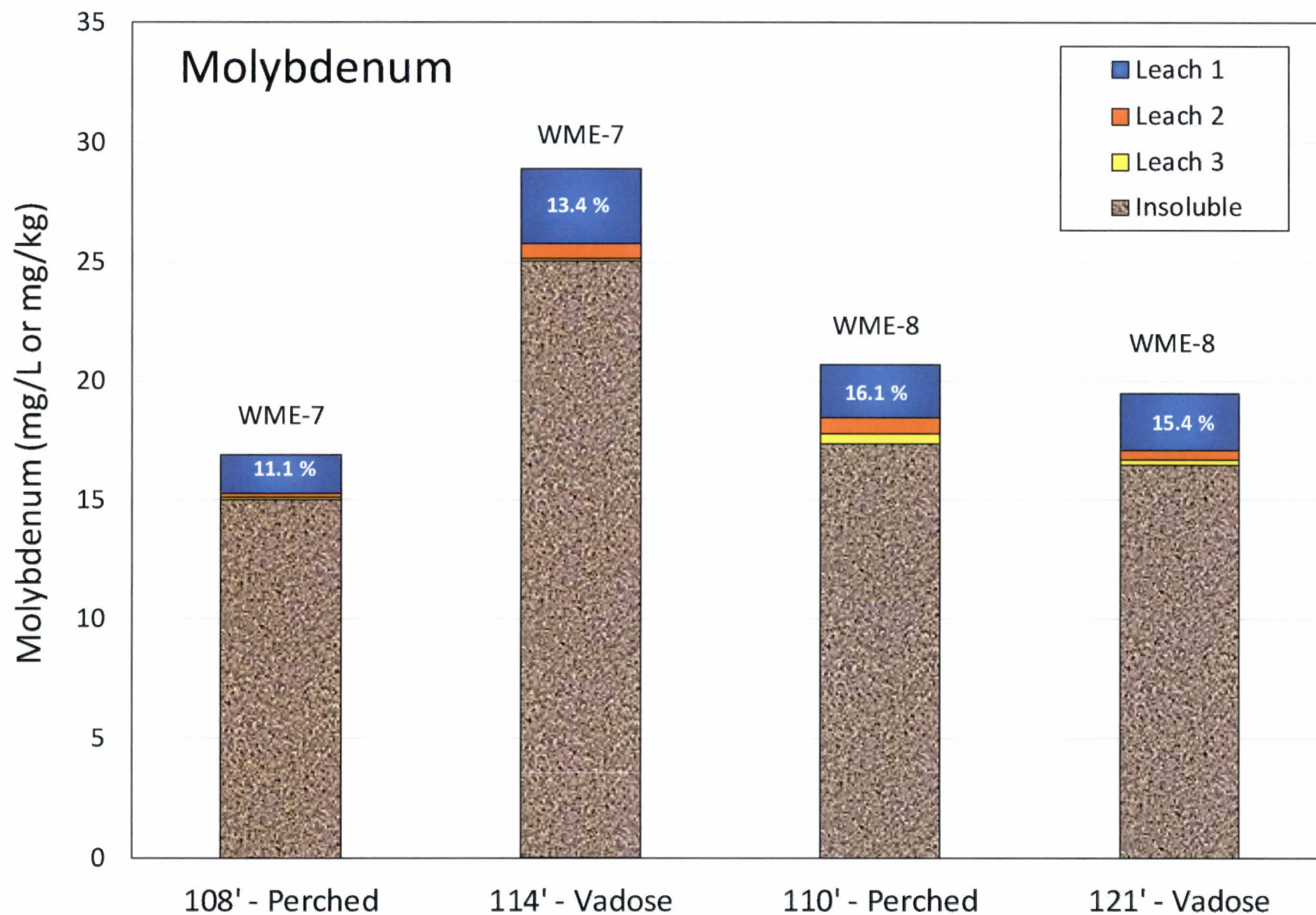


Figure 33. MWMP Results for Molybdenum in Alluvium.

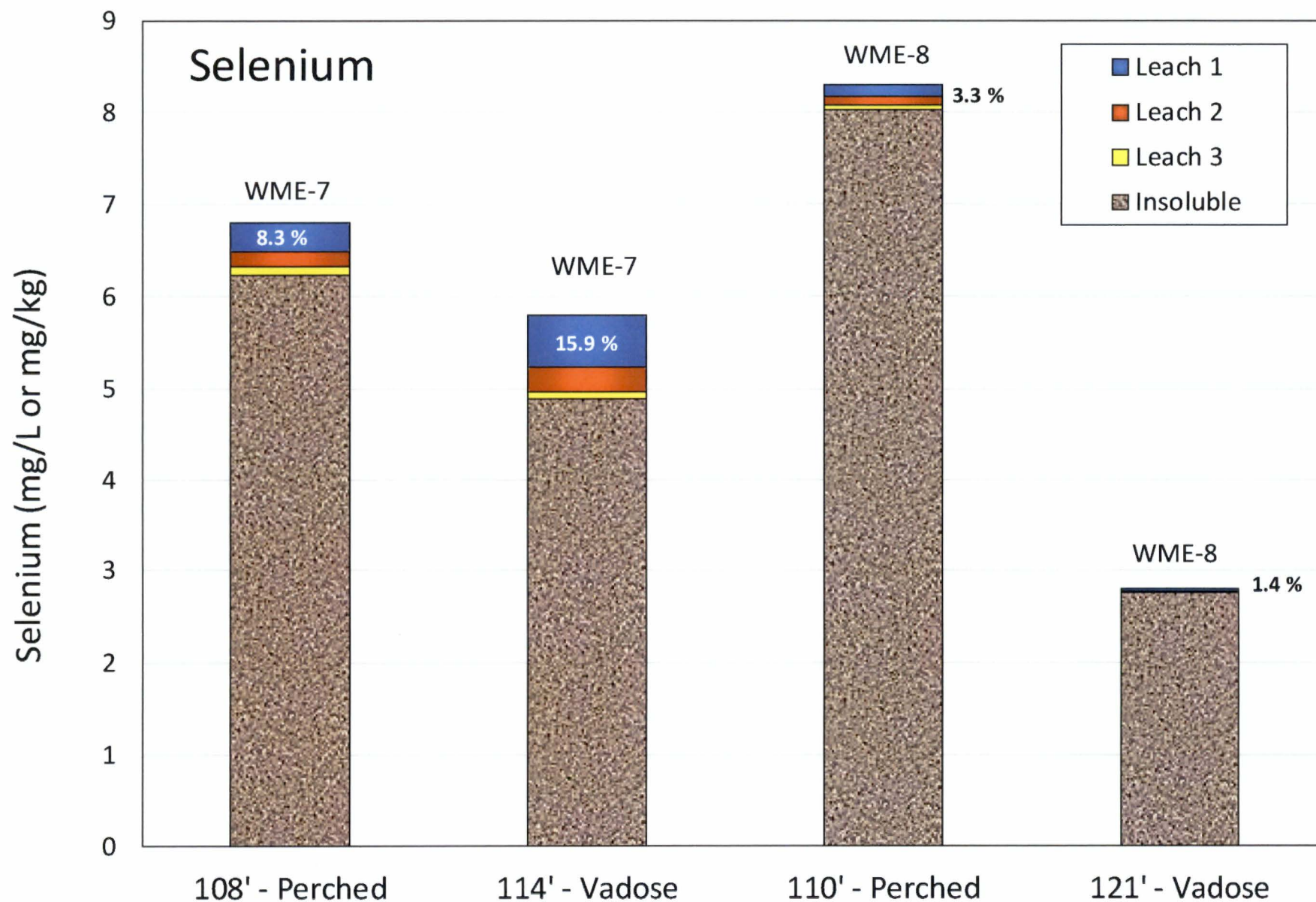


Figure 34. MWMP Results for Selenium in Alluvium.

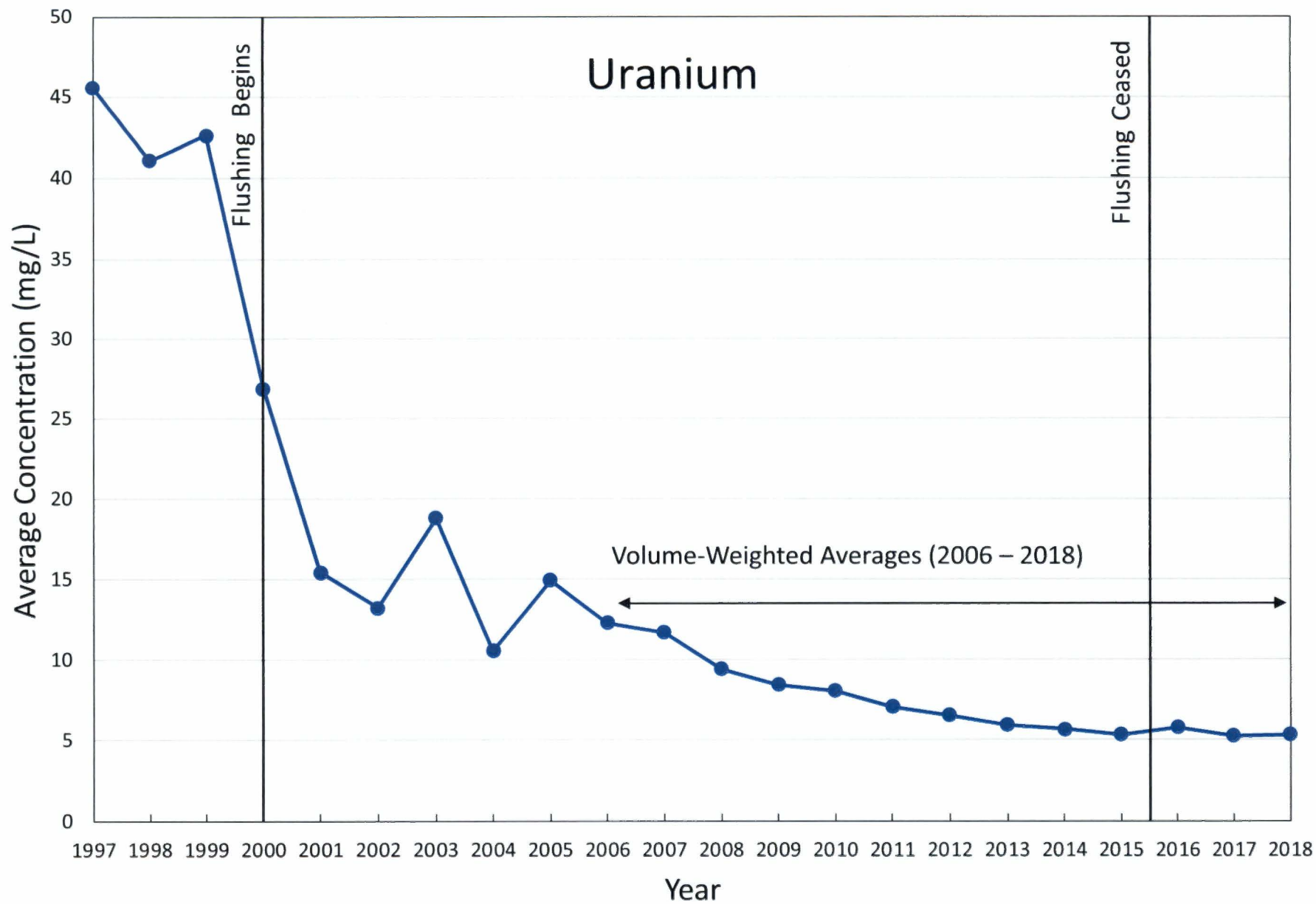


Figure 35. Average Uranium Concentrations for LTP Wells (1997-2018).

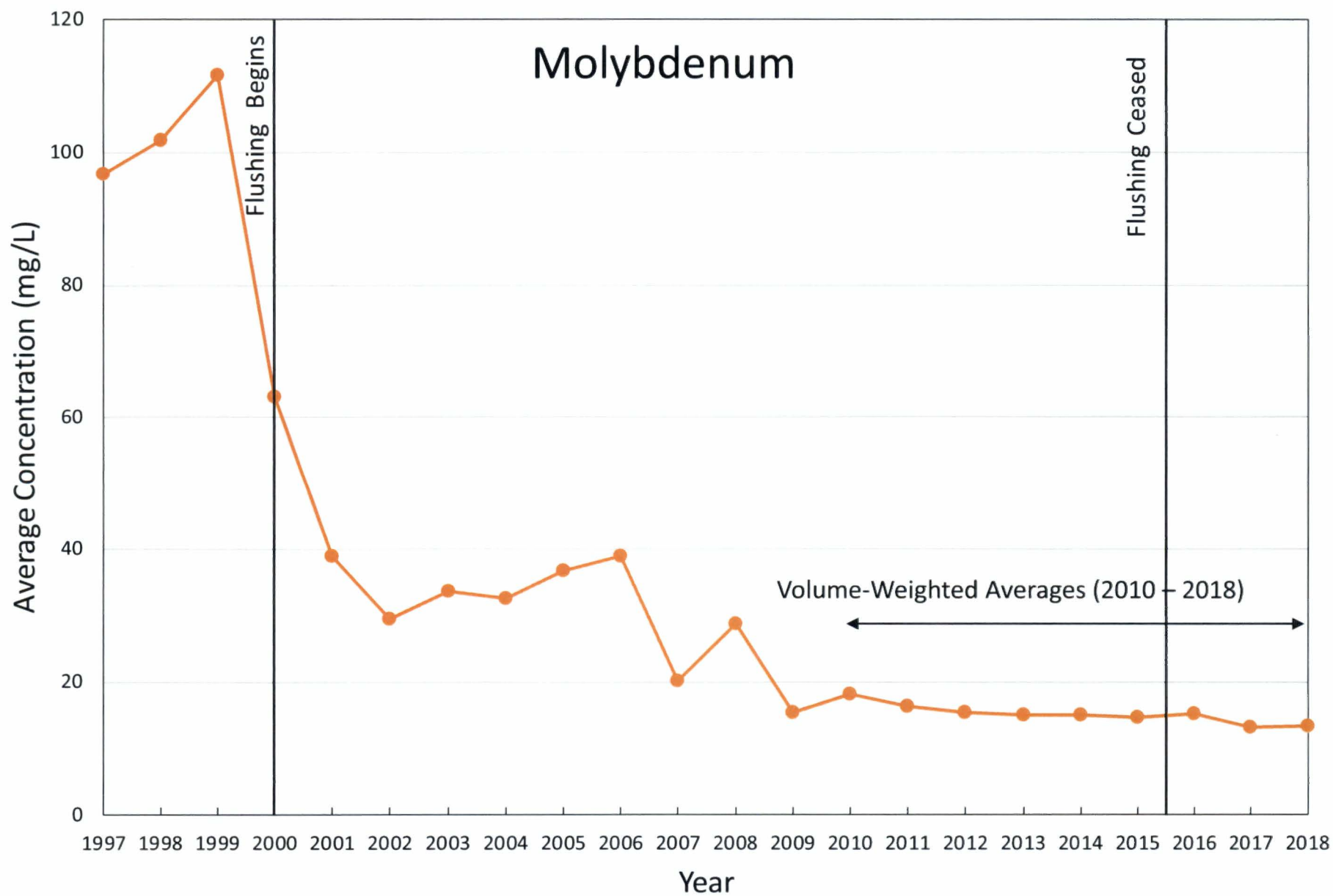


Figure 36. Average Molybdenum Concentrations for LTP Wells (1997-2018).

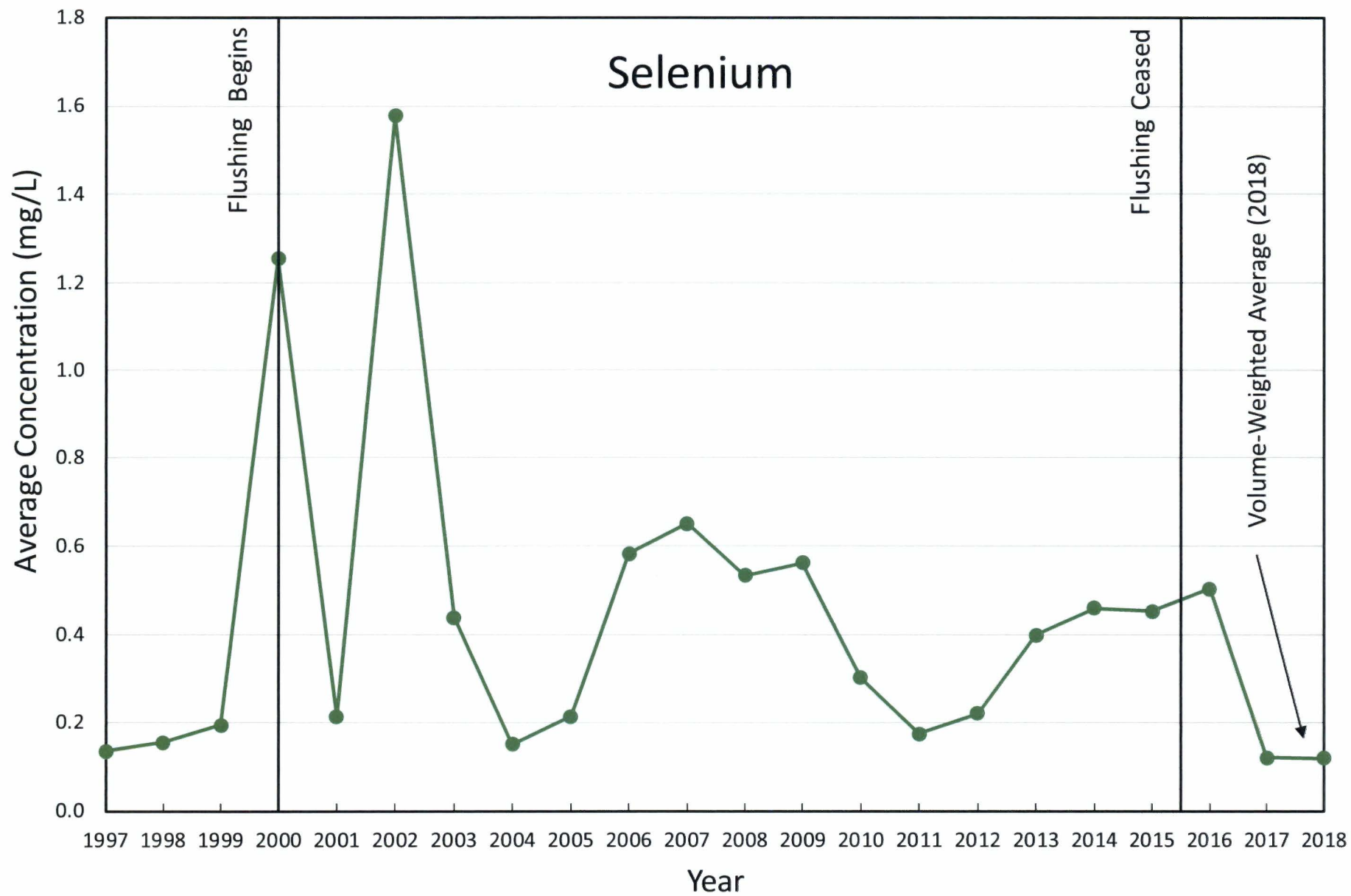


Figure 37. Average Selenium Concentrations for LTP Wells (1997-2018).

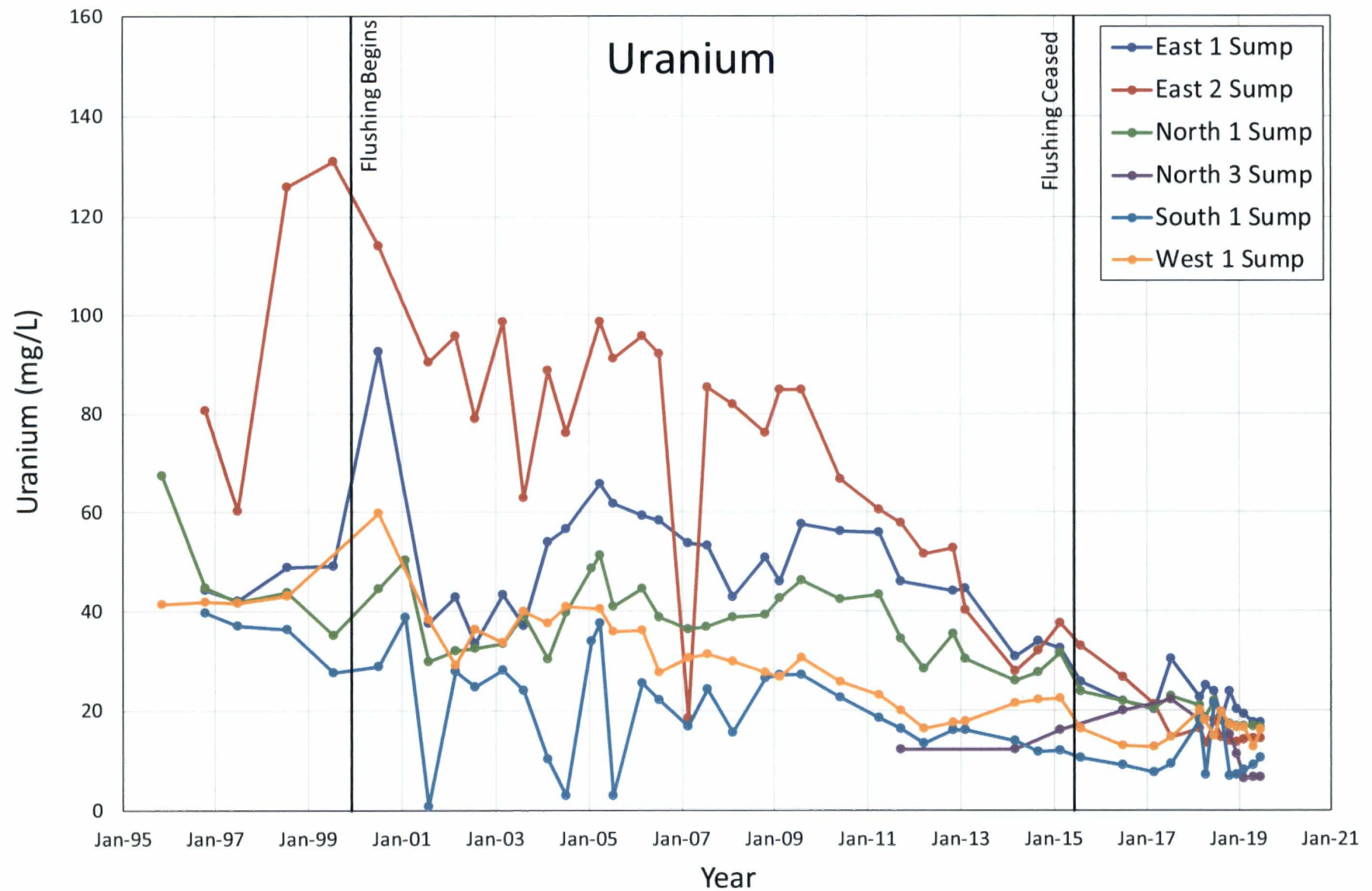


Figure 38. Uranium Concentrations for LTP Sumps (1995-2019).

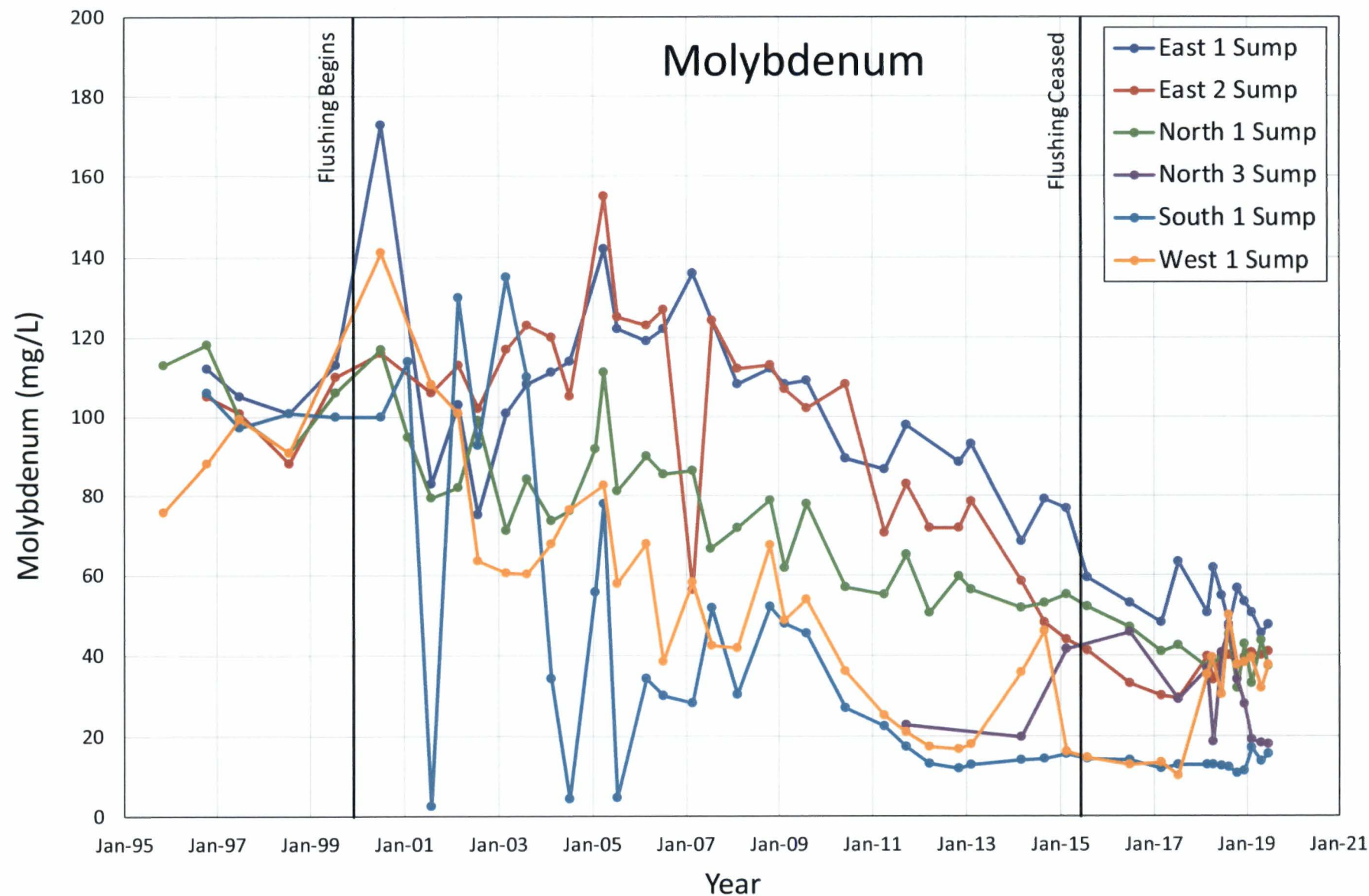


Figure 39. Molybdenum Concentrations for LTP Sumps (1995-2019).

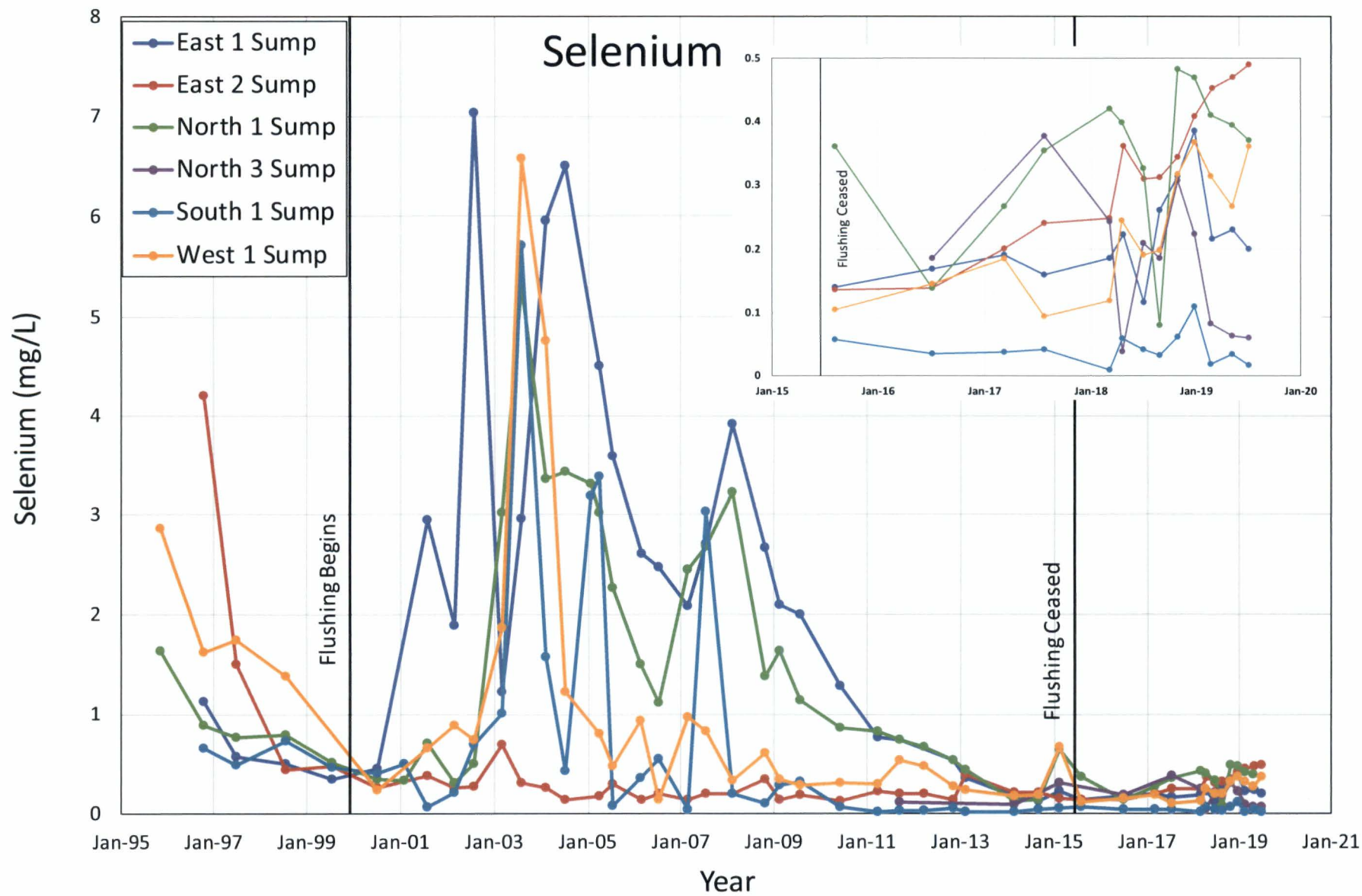


Figure 40. Selenium Concentrations for LTP Sumps (1995-2019).

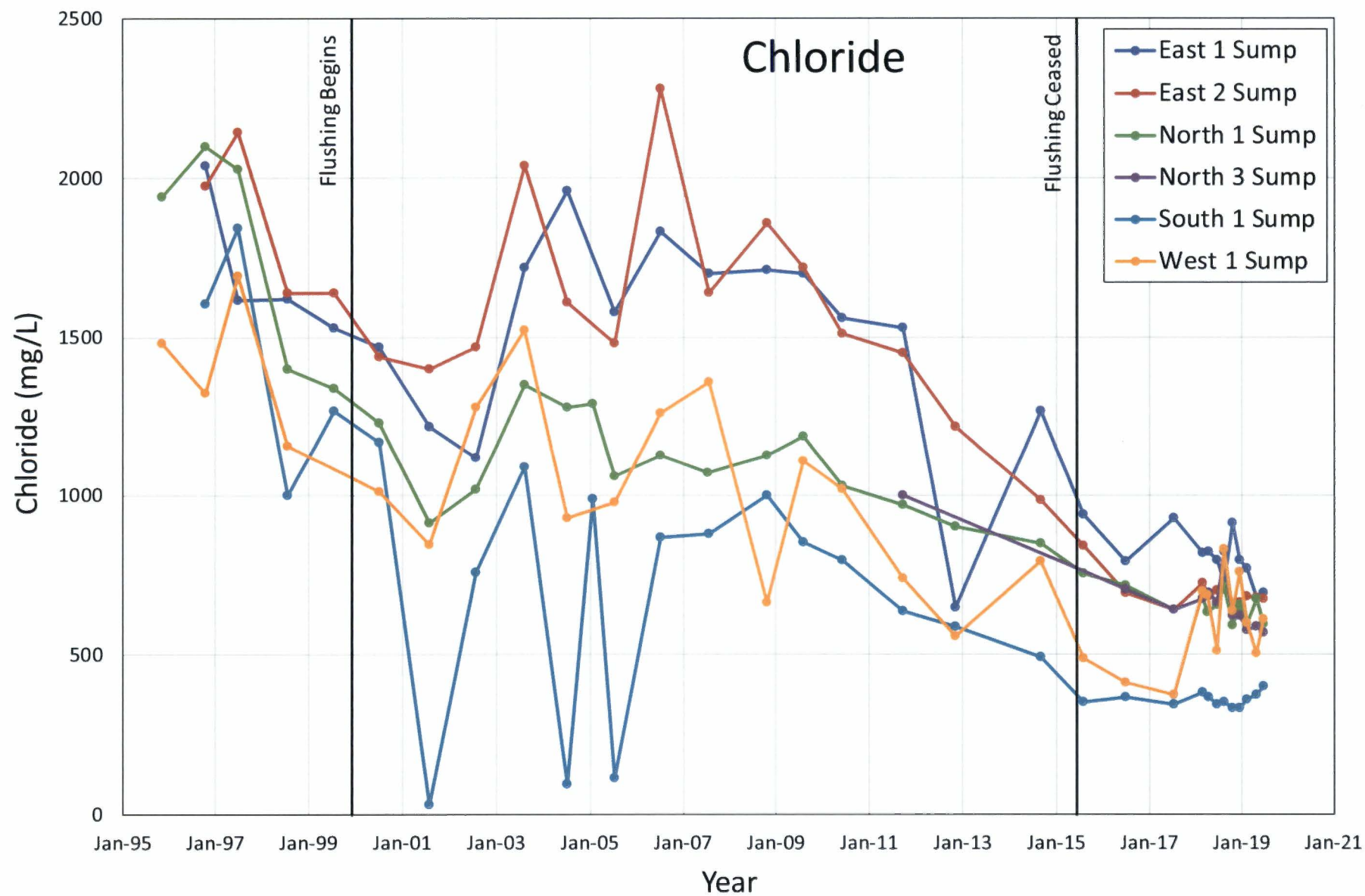


Figure 41. Chloride Concentrations for LTP Sumps (1995-2019).

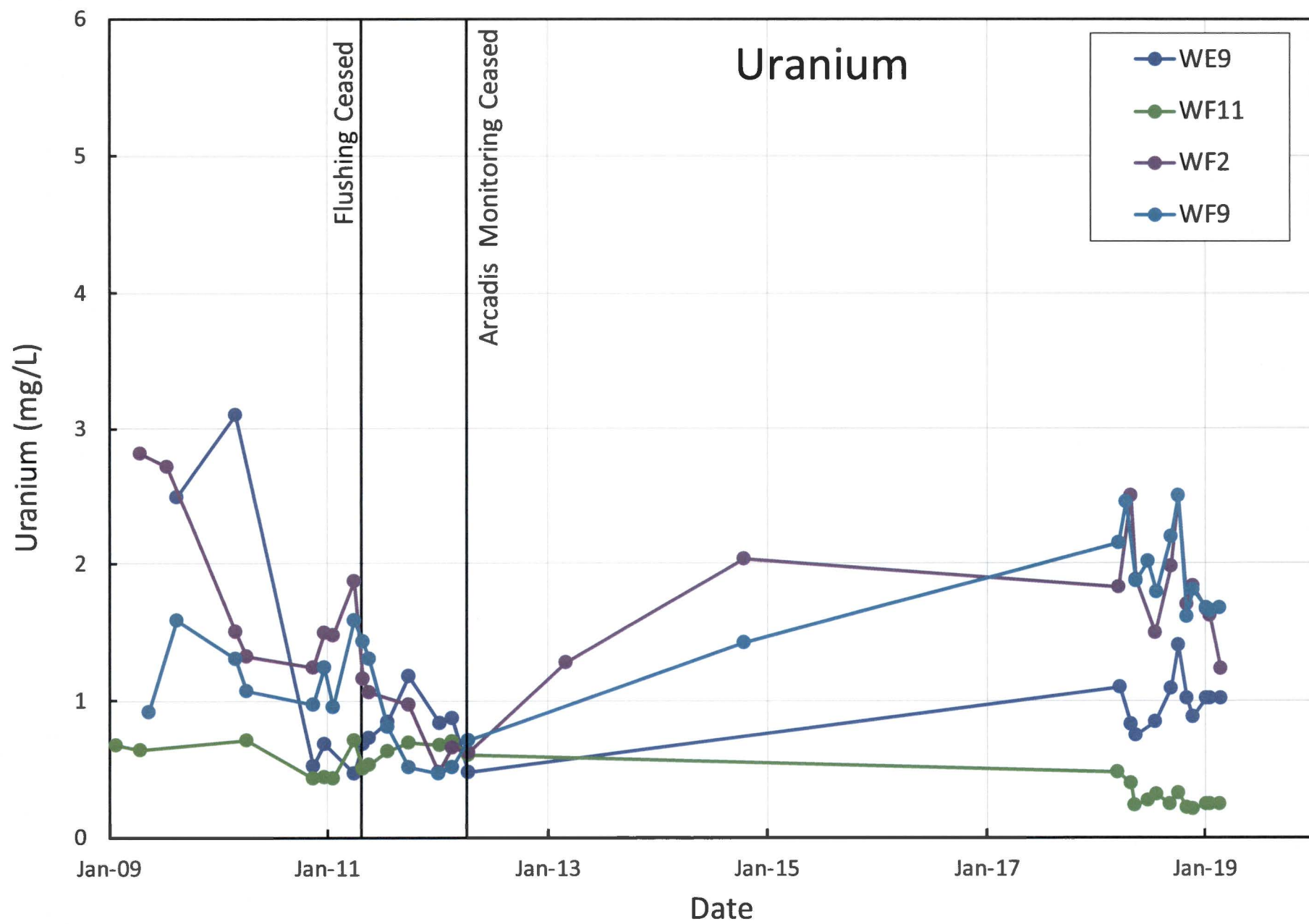


Figure 42. Uranium Concentrations for LTP Arcadis Wells (2009-2019).

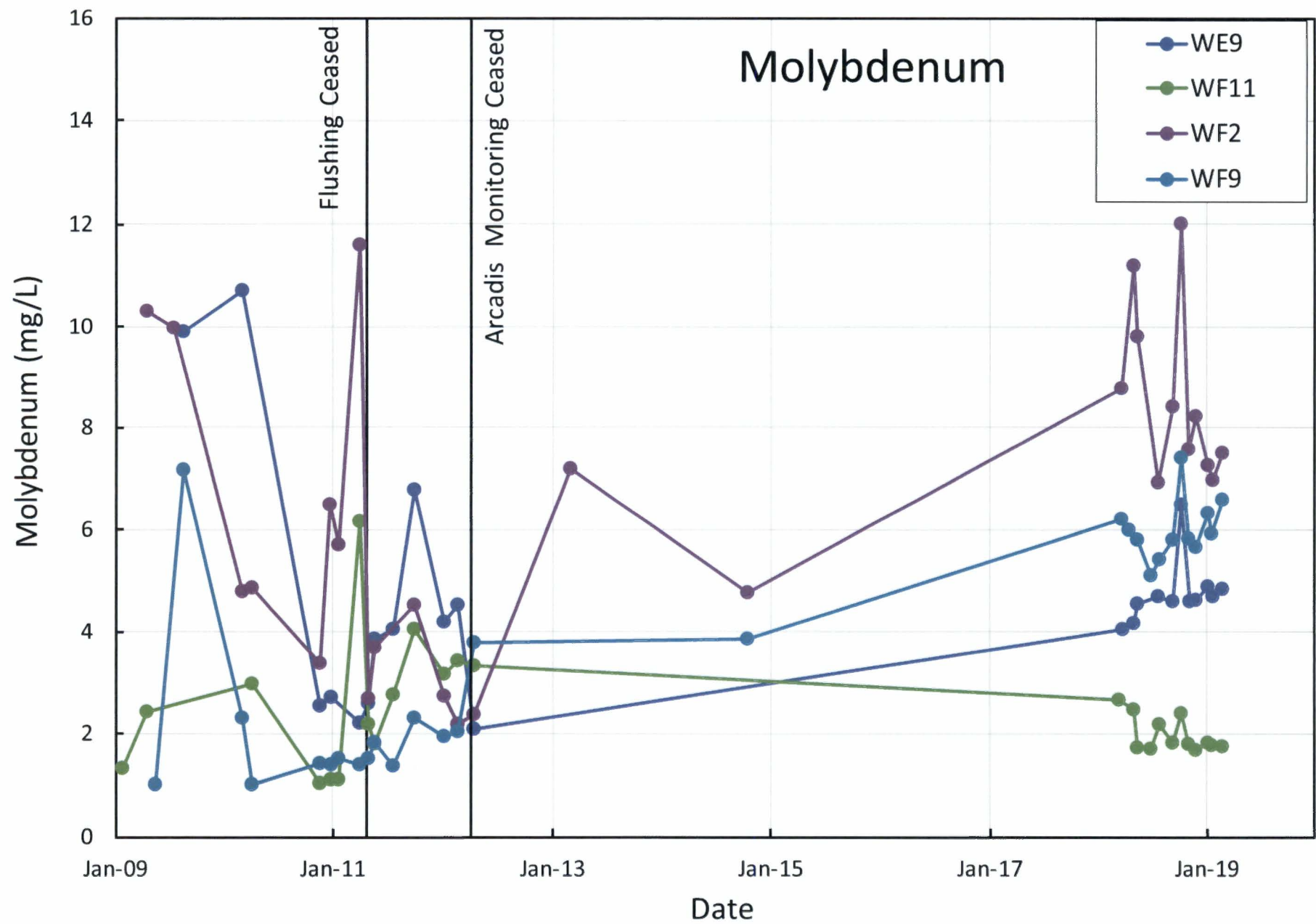


Figure 43. Molybdenum Concentrations for LTP Arcadis Wells (2009-2019).

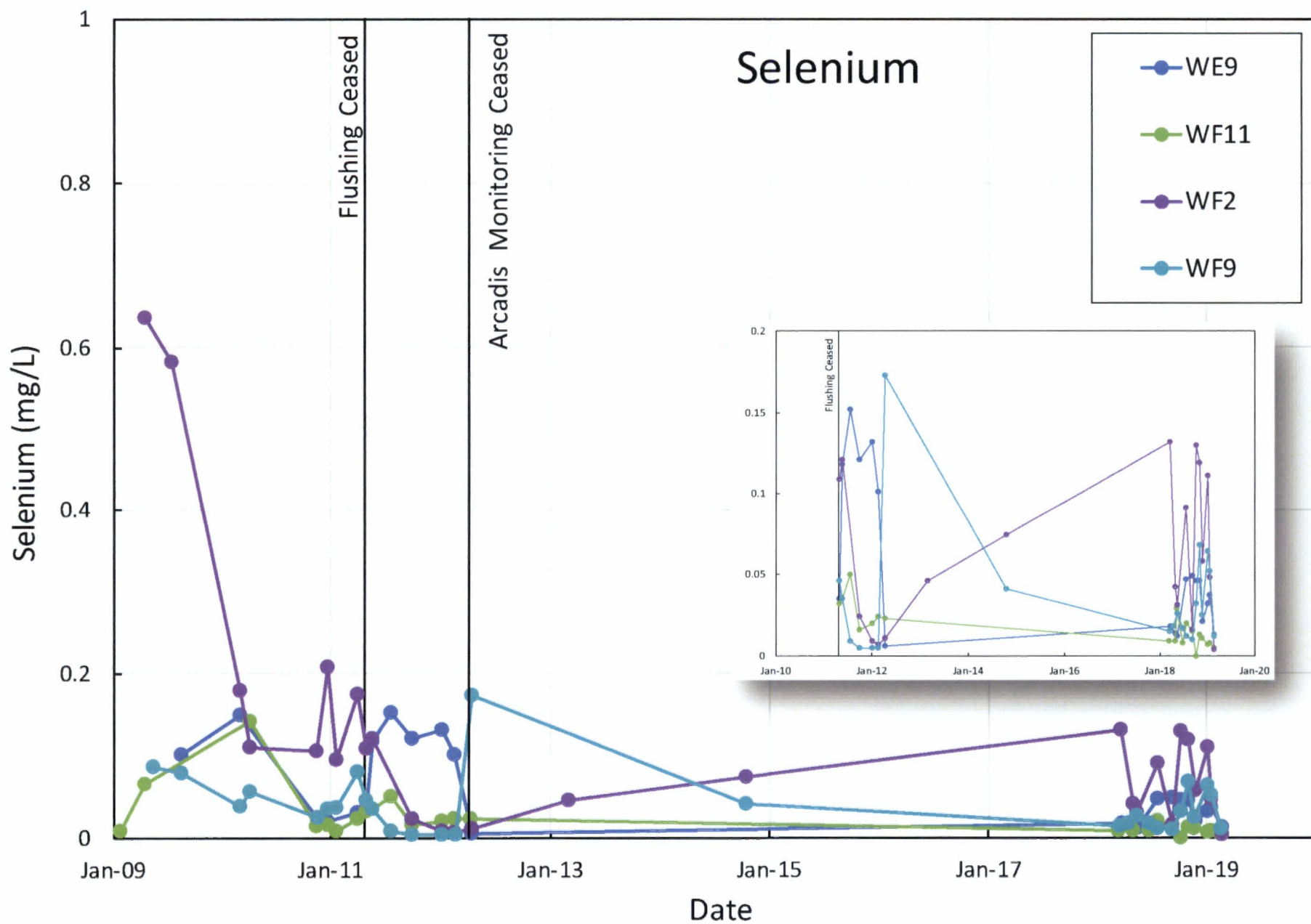


Figure 44. Selenium Concentrations for LTP Arcadis Wells (2009-2019).

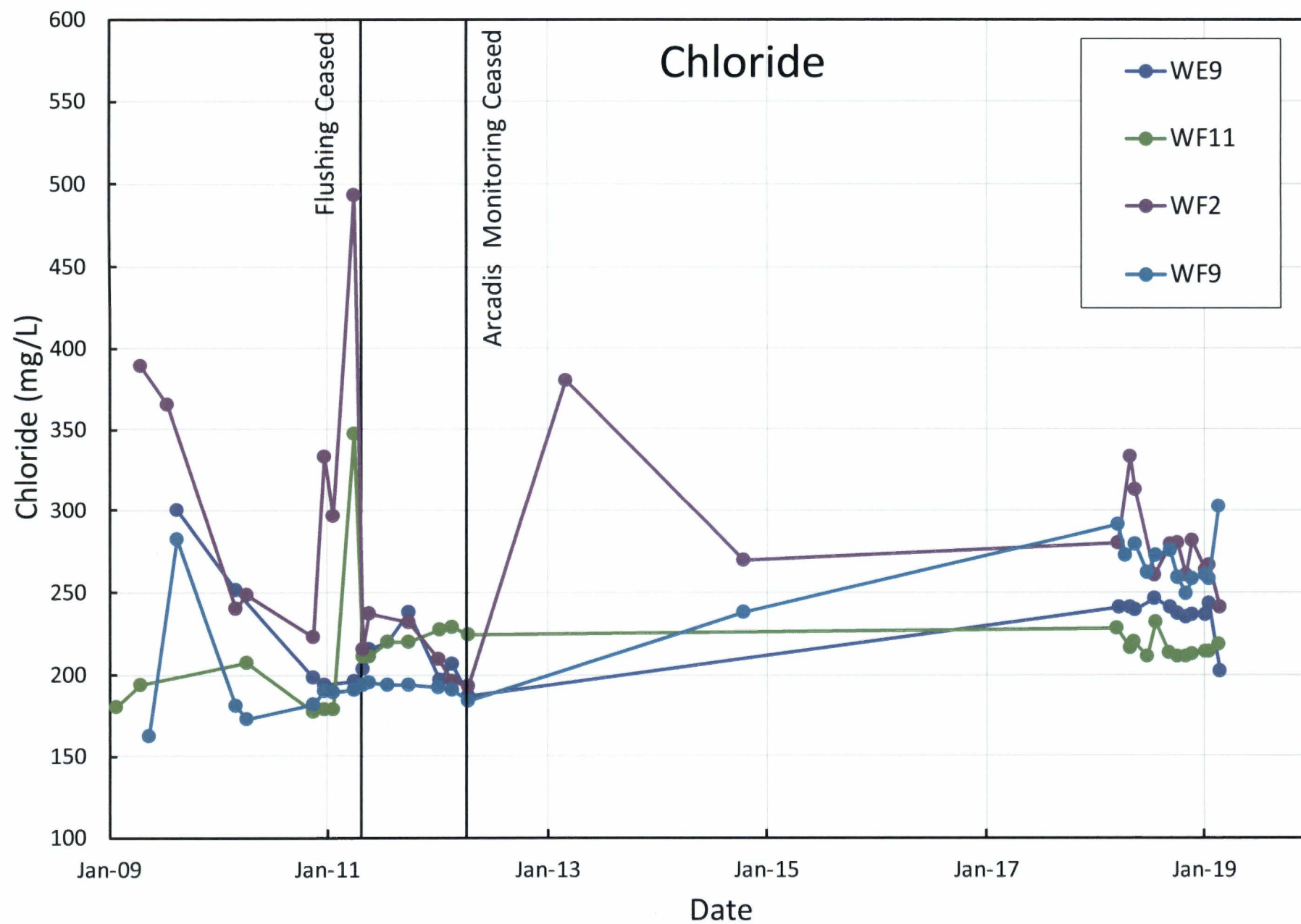


Figure 45. Chloride Concentrations for LTP Arcadis Wells (2009-2019).

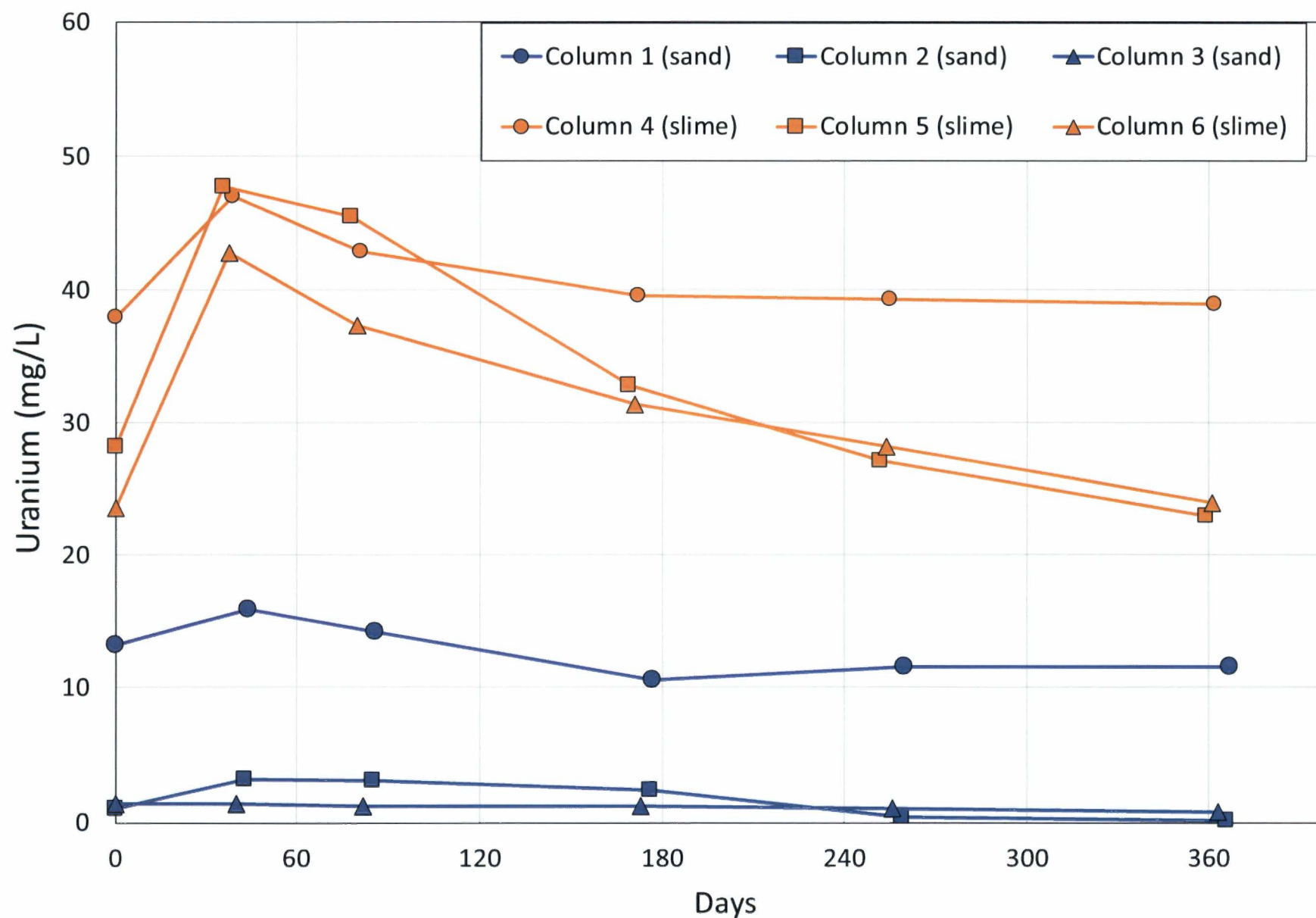


Figure 46. Uranium Concentrations in LTP Columns.

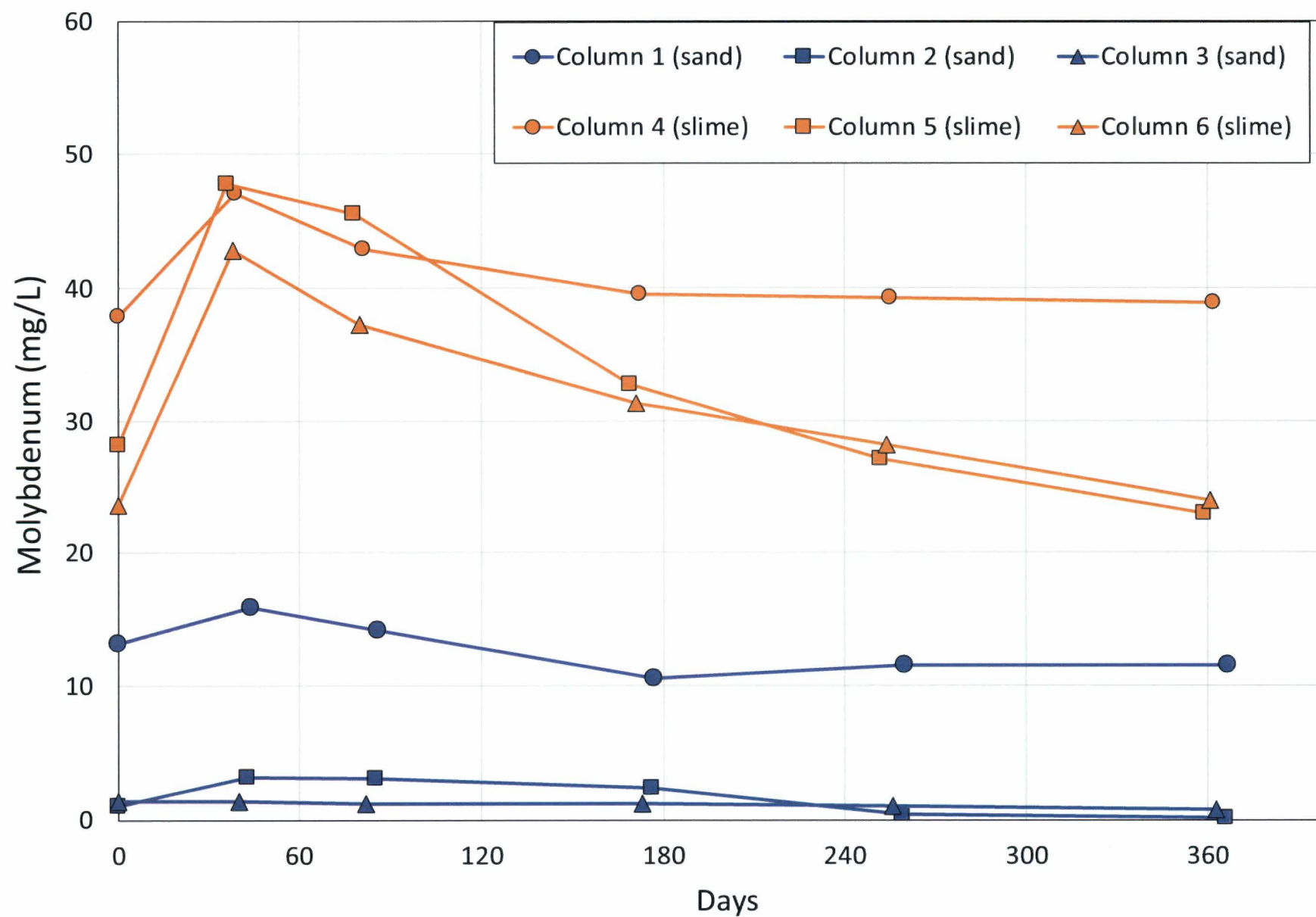


Figure 47. Molybdenum Concentrations in LTP Columns.

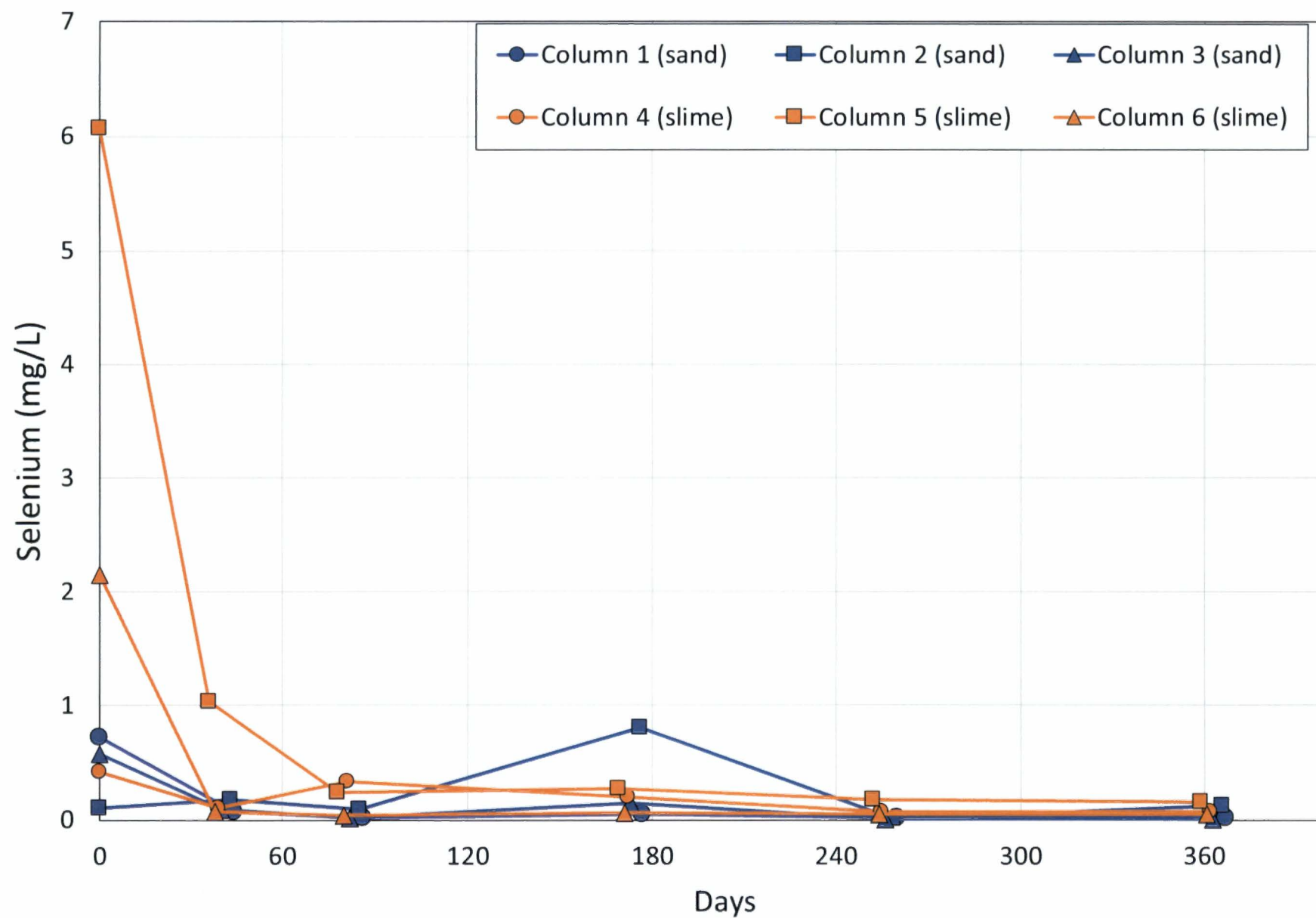


Figure 48. Selenium Concentrations in LTP Columns.

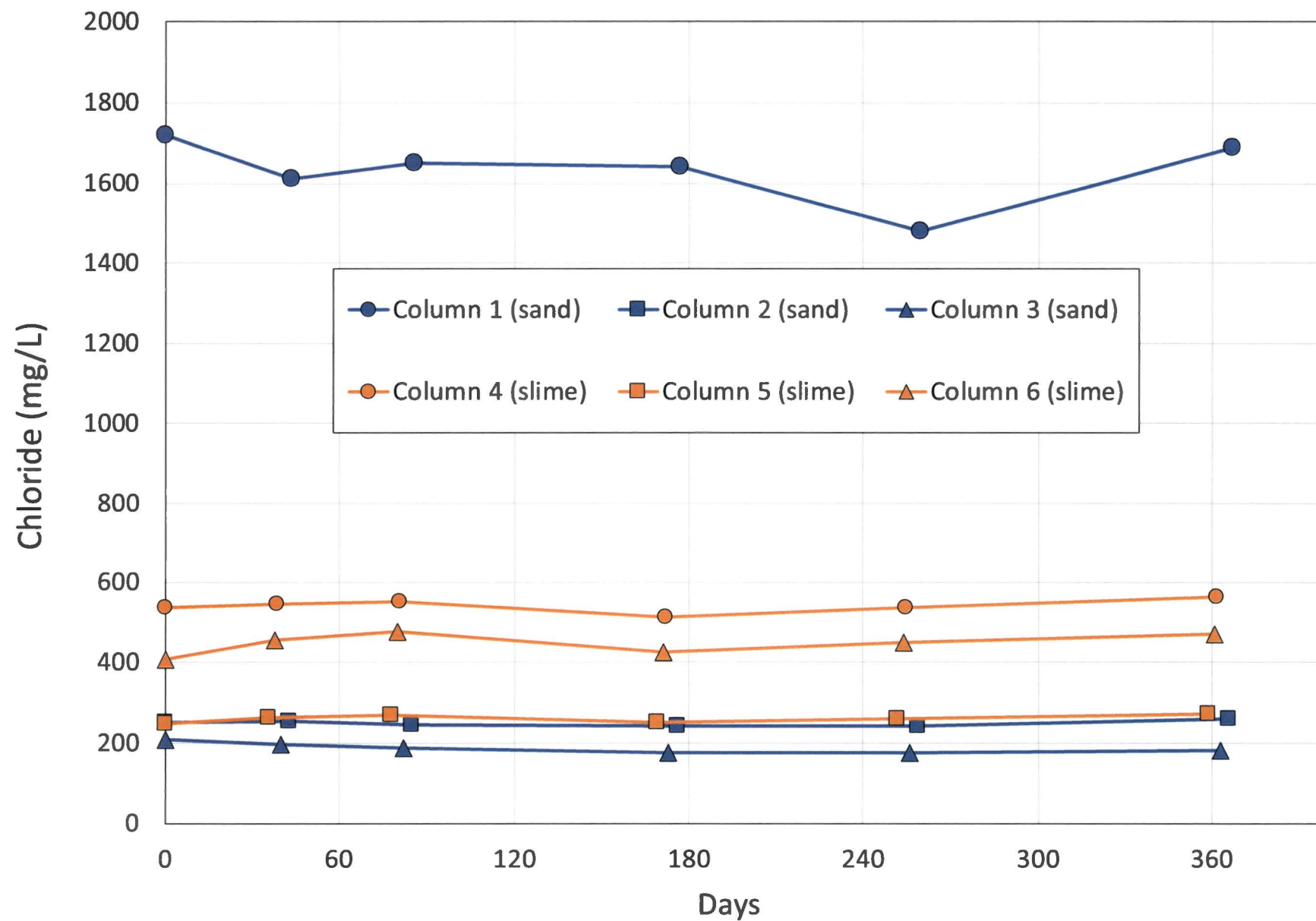


Figure 49. Chloride Concentrations in LTP Columns.

Attachment 1
Drilling Completion Memorandum

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DRAFT DRILLING COMPLETION MEMORANDUM

TO: THOMAS WOHLFORD, CLOSURE MANAGER, HOMESTAKE MINING COMPANY
FROM: ROB NOBLE, P.G., AND DAVID LEVY, PH.D., WORTHINGTON MILLER ENVIRONMENTAL
SUBJECT: COMPLETION REPORT FOR MONITORING WELL INSTALLATION AND ALLUVIAL BORING SAMPLE COLLECTION FOR GEOCHEMICAL CHARACTERIZATION AT THE HOMESTAKE GRANTS RECLAMATION PROJECT, CIBOLA COUNTY, NEW MEXICO.
DATE: JULY 17, 2018

1.0 Introduction

Between June 13, 2018 and June 25, 2018, six monitoring wells were installed in the Large Tailings Pile (LTP), two monitoring wells were installed in the Small Tailings Pile (STP), and seven borings were drilled into the alluvial aquifer for solids sample collection and analyses at the Homestake Grants Reclamation Project Site (Site). All work was performed according to the *Draft Geochemical Characterization Work Plan*, Version 2 (WME, 2018) which describes the project objectives.

2.0 Monitoring Well Drilling and Installation

Six new monitoring wells were installed in the LTP at predetermined locations (Figure 1). Wells WME-1, WME-2 and WME-3 were drilled and completed in tailings sands material in the LTP. Wells WME-4, WME-5 and WME-6 were completed in tailings slimes material in the LTP. In addition, two new monitoring wells were installed in the STP (Figure 2). Well WME-9 was completed in the alluvium below the STP sands, while WME-10 was completed in the alluvium below the STP slimes.

Boreholes were drilled by Cascade Drilling using a Sonic drill rig with temporary casing advance capability. Nine-inch diameter temporary steel casing was advanced during drilling to prevent borehole collapse. Drill cuttings were collected with an 8-inch diameter core barrel. All wells were completed with flush-threaded 4-inch schedule 40 PVC pipe. All well screens are 5-foot lengths with 0.010 slot size. Filter pack material consists of clean 10-20 silica sand. One foot of #60 silica sand was placed on top of the filter pack to prevent grout from entering the filter pack. Boreholes were sealed with a high-solids bentonite grout and finished with bentonite chips. The surface completion for each well consists of an 8-inch diameter steel protective casing with a locking lid and a cement pad. Table 1 provides construction information for each new monitoring well. Well completion diagrams are provided in Appendix A. Field notes are provided in Appendix B. Photographs of drill cuttings in chip trays are provided in Appendix C.

2.1 Monitoring Well Development

All monitoring wells were developed by Cascade Drilling. Wells were surged with a surge block, bailed with a PVC bailer and pumped with a small down-hole pump. Table 2 provides development records for each well, including depth to water before and after development, total volume purged and final field parameters.

2.2 Column Test Filling and Sampling

The six wells drilled and completed in the LTP each have an associated column test that is set up on Site (WME, 2018). Each PVC column is 8-inch diameter by 4-feet tall. Each column was filled with material excavated during drilling from the screened interval of each well. After each well was developed, a sample was collected and the corresponding column was filled with the tailings water. Table 3 provides information related to the columns including depth of the sample, the filling date for each column and pH of the first sample taken 24 hours after filling.

2.3 Tailings Sample Collection

In addition to the tailings material collected for the column tests, material was collected for additional geochemical characterization (WME, 2018). Table 4 provides sample dates, depths, amount of material collected and the laboratory analyses that will be performed on each sample.

3.0 Alluvial Aquifer Drilling and Sample Collection

Nine alluvial borings were drilled at pre-determined sites (Figure 3) to collect alluvial solids for geochemical testing (WME, 2018). Table 4 provides sample date, depths, sample amount and laboratory analyses to be performed on each sample. Note that an alluvial sample was not collected from locations WME-12 and WME-13 as originally proposed (WME, 2018) because the drill stem hit refusal on igneous bedrock before groundwater was encountered.

4.0 References

Worthington Miller Environmental LLC (WME). 2018. Draft Geochemical Characterization Work Plan, Grants Reclamation Project. Version 2. Prepared for Homestake Mining Company of California. May.

Table 1: Well Completion Information.

Well ID	Completion Lithology	Well Total Depth (Feet TOC)	Top Screen (Feet TOC)	Depth To Water (Feet TOC)	Saturated Thickness (Feet)	Well Volume (Gallons)
WME-1	LTP Sands	57.30	51.80	53.45	3.85	2.5
WME-2	LTP Sands	64.60	59.10	57.25	7.35	4.8
WME-3	LTP Sands	72.65	67.15	61.30	11.35	7.4
WME-4	LTP Slimes	67.60	62.10	57.49	10.11	6.6
WME-5	LTP Slimes	77.32	71.82	66.98	10.34	6.8
WME-6	LTP Slimes	67.25	61.75	54.95	12.30	8.0
WME-9	Alluvium	73.20	67.70	58.50	14.70	9.6
WME-10	Alluvium	76.70	71.20	58.90	17.80	11.6

Table 2: Well Development Information.

Well ID	Initial Depth to Water (feet TOC)	Casing Volume (gallons)	Total Volume Purged (gallons)	Final pH	Final Specific Conductivity (μS/cm)	Final Temp (°C)	Final Depth to Water (feet TOC)
WME-1	53.25	2.8	8.5	9.92	22,274	14.8	53.45
WME-2	59.29	3.8	19	9.42	4,881	14.4	57.25
WME-3	59.30	7.3	23	9.63	3,880	16.1	61.30
WME-4	57.95	6.3	12	10.06	26,220	14.6	57.49
WME-5	59.86	11.3	19	9.42	3,354	14.5	66.98
WME-6	55.67	7.5	22	10.37	12,312	13.2	54.95
WME-9	55.90	11.3	20	7.52	1,938	18.9	58.50
WME-10	58.53	11.8	25	7.44	2,244	17.4	58.90

Table 3: LTP Column Setup Information.

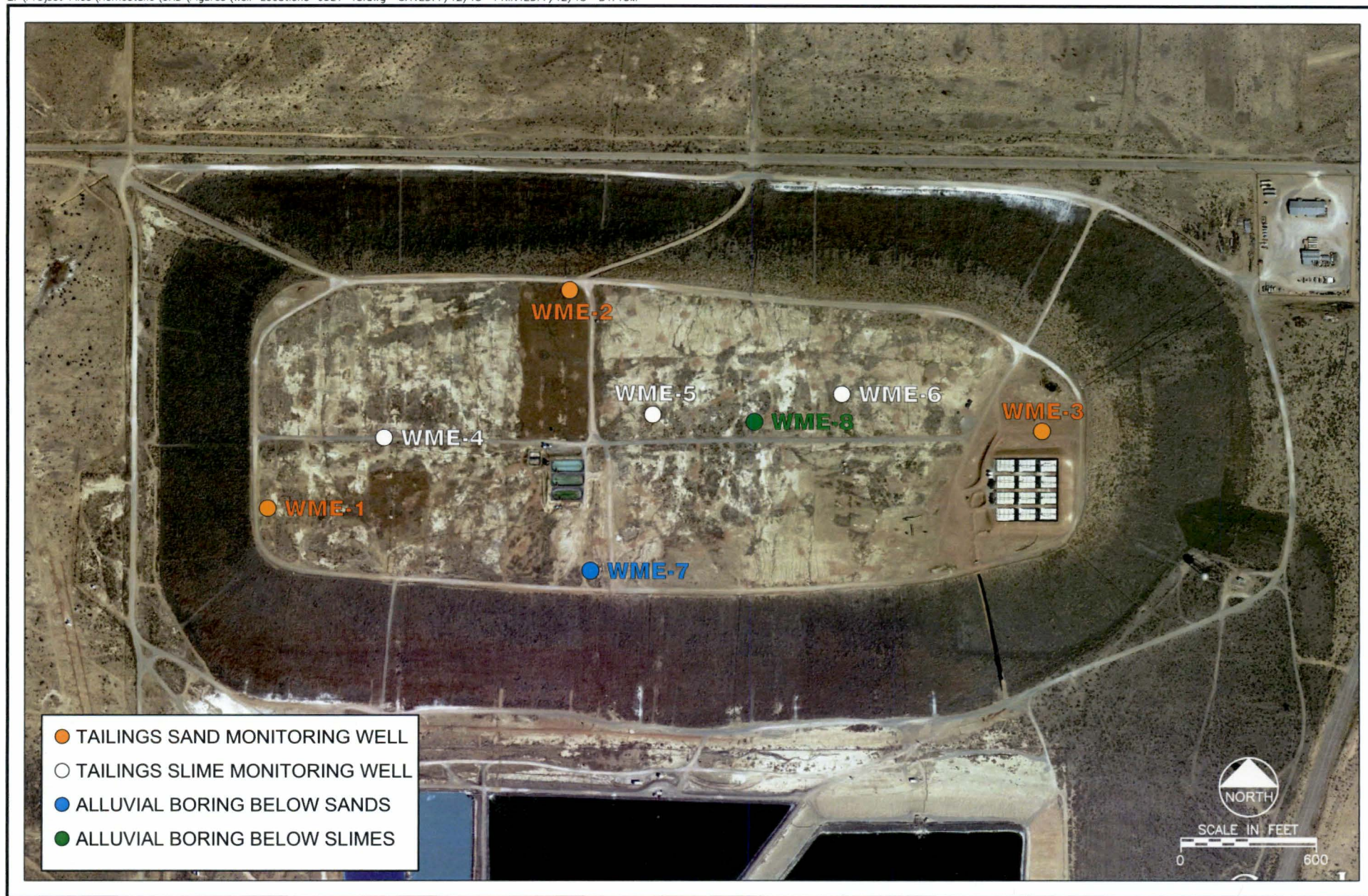
Location	Description	Sample Depth	Solid-Phase Collection Date	Tailings Water Fill Date	24-hour Sample pH
WME-1	LTP Sands	50'-54'	6/14/2018	6/17/2018	9.96
WME-2	LTP Sands	56'-60'	6/15/2018	6/18/2018	9.64
WME-3	LTP Sands	61'-65'	6/15/2018	6/21/2018	9.68
WME-4	LTP Slimes	61'-65'	6/17/2018	6/22/2018	9.96
WME-5	LTP Slimes	70'-74'	6/18/2018	6/25/2018	10.25
WME-6	LTP Slimes	60'-64'	6/19/2018	6/23/2018	10.19

Table 4: Summary of Solids Sample Collection.

Location	Description	Sample Depth	Sample Mass Collected	ACZ Quote No.					
				ABA-PH-CEC-TOC	XRD	HCT	TESSIER-6-STEP	SEM	MWMP-COLUMN
WME-1	LTP Sands	55'	1 kg	X	X				
WME-2	LTP Sands	61'	3 kg	X	X	X	X	X	
WME-3	LTP Sands	65'	1 kg	X	X		X		
WME-4	LTP Slimes	65'	1 kg	X	X				
WME-5	LTP Slimes	75'	3 kg	X	X	X	X	X	
WME-6	LTP Slimes	65'	1 kg	X	X		X		
WME-7	Perched Alluvium	108'	6 kg	X	X		X		X
WME-7	Vadose Alluvium	113'	6 kg	X	X		X		X
WME-8	Perched Alluvium	110'	6 kg	X	X			X	X
WME-8	Vadose Alluvium	121'	6 kg	X	X				X
WME-9	STP Sands	30'	3 kg	X	X	X	X		
WME-10	STP Slimes	35'	3 kg	X	X	X	X	X	
WME-11	Alluvium	65'	1 kg	X	X		X		
WME-12	Alluvium	No Sample							
WME-13	Alluvium	No Sample							
WME-14	Alluvium	45'	1 kg	X	X		X		
WME-15	Alluvium	55'	1 kg	X	X				
WME-16	Alluvium	65'	1 kg	X	X		X	X	
WME-17	Alluvium	55'	1 kg	X	X				
Total				17	17	4	11	5	4

Figures

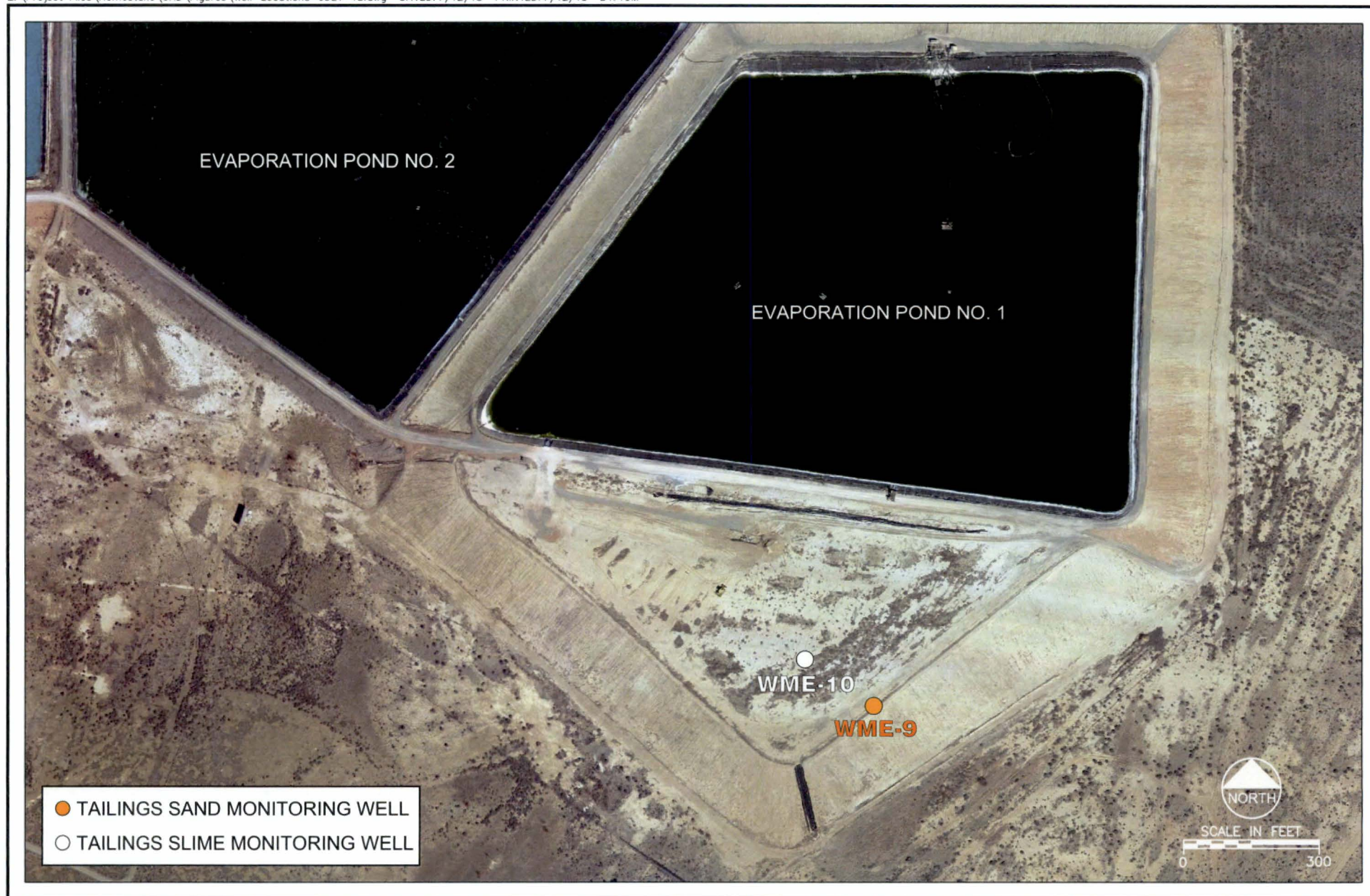
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WORTHINGTON
MILLER
ENVIRONMENTAL, LLC.

FIGURE 1
LOCATION OF NEW LTP WELLS AND ALLUVIAL BORINGS FOR SOLIDS
COLLECTION AND WATER QUALITY EVALUATION

Date:	JULY 2018
Project:	HOMESTAKE
File:	WELL-LOCATIONS-JULY-18



WORTHINGTON
MILLER
ENVIRONMENTAL, LLC.

FIGURE 2
LOCATIONS OF NEW STP SAND AND SLIME WELLS FOR TAILINGS
SOLIDS COLLECTION AND WATER QUALITY EVALUATION

Date:	JULY 2018
Project:	HOMESTAKE
File:	WELL-LOCATIONS-JULY-18



WORTHINGTON
MILLER
ENVIRONMENTAL, LLC.

FIGURE 3
LOCATIONS FOR ALLUVIAL AQUIFER SOLIDS COLLECTION

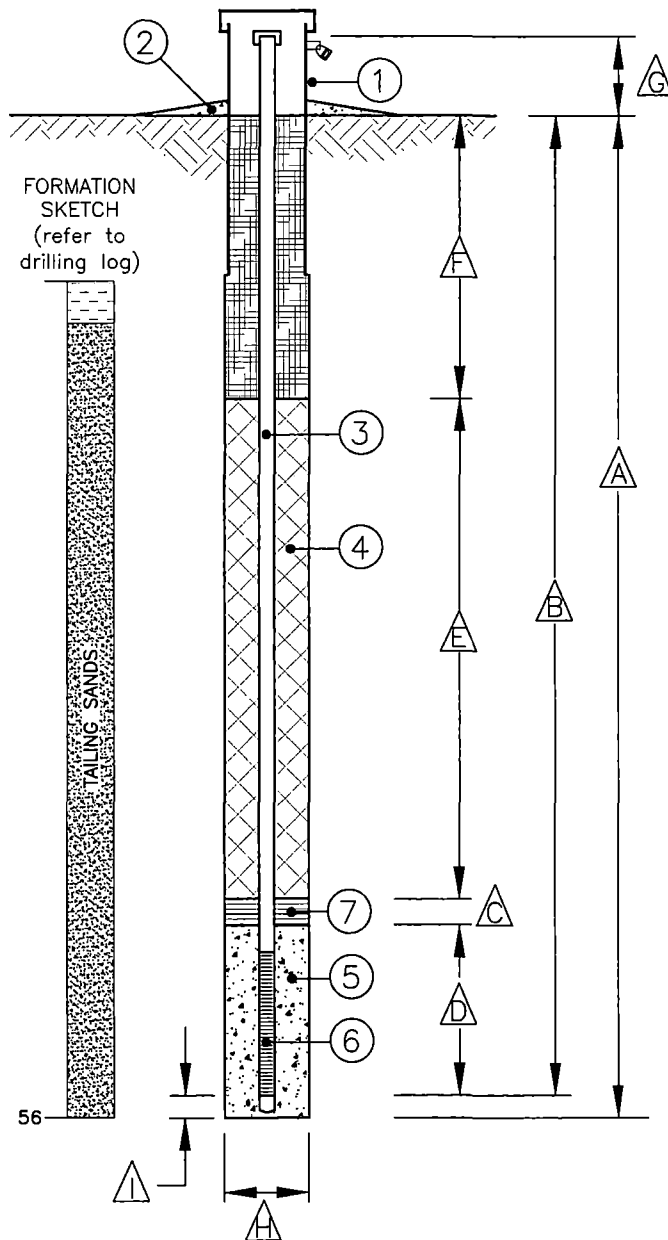
Date:	JULY 2018
Project:	HOMESTAKE
File:	WELL-LOCATIONS-JULY-18

Appendix A

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WME-1

MONITORING WELL CONSTRUCTION INFORMATION SHEET



Project HOMESTAKE GRP
 Well number WME-1
 Date 06-28-2018
 Drilling company CASCADE
 Location LTP SAND
 Date drilled 06-14-2018
 Date completed 06-15-2018

Materials:

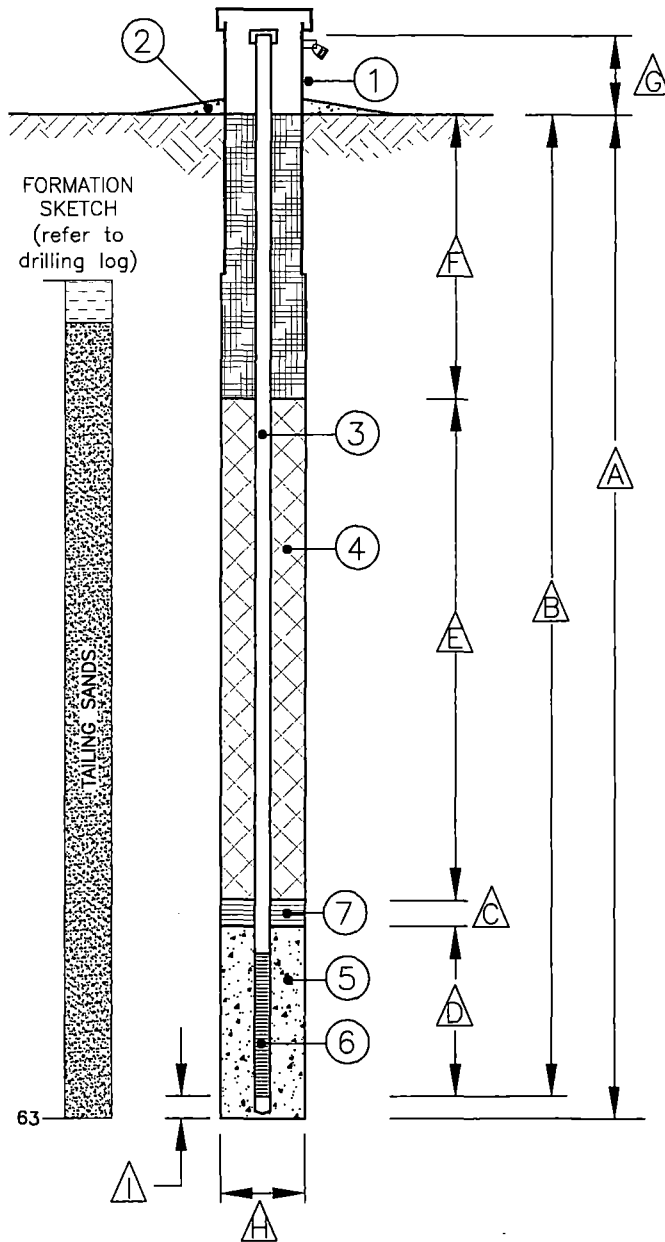
- ① Protective casing? ☒ Yes ☐ No
 Height above ground 2.5 ft
 Type STEEL Length 5' Dia. 8"
- ② Cement pad? ☒ Yes ☐ No
- ③ Solid pipe: Type PVC Length 51.8' Dia. 4"
- ④ Seal type: HIGH SOLIDS BENTONITE GROUT
- ⑤ Filter pack: 10-20 SILICA SAND
- ⑥ Well screen: Type PVC Length 5' Dia. 4"
 Slot size 0.010
- ⑦ Sand type: #60 SILICA

Dimensions:

- △ A Total depth of boring 56.0 ft
- △ B Total depth of finished well 55.6 ft
- △ C Sand: Interval 46-47 ft
- △ D Filter pack: Interval 47-56 ft
- △ E Seal: Interval 15-46 ft
- △ F Bentonite chip seal: Interval 3-15 ft
- △ G Height of stick-up 1.7 ft
- △ H Borehole diameter 8.0 in
- △ I Length of endcap 0.5 ft

WME-2

MONITORING WELL CONSTRUCTION INFORMATION SHEET



Project HOMESTAKE GRP
 Well number WME-2
 Date 06-28-2018
 Drilling company CASCADE
 Location LTP SAND
 Date drilled 06-14-2018
 Date completed 06-15-2018

Materials:

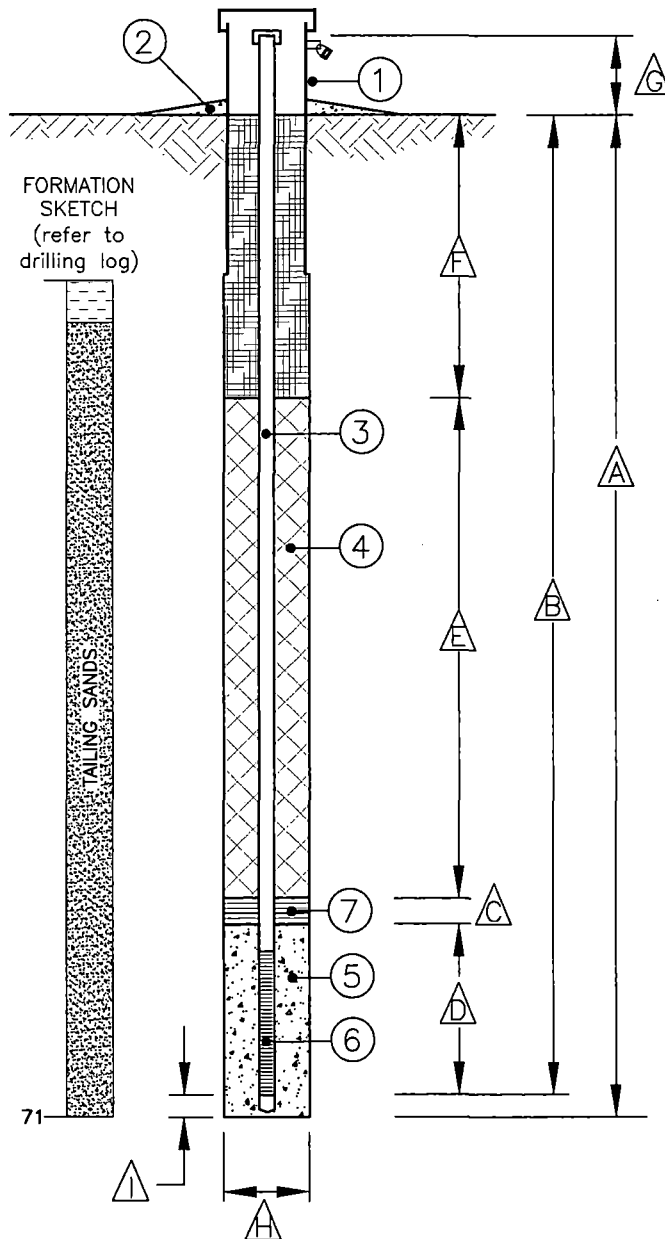
- ① Protective casing? ☒ Yes No
 Height above ground 2.5 ft
 Type STEEL Length 5' Dia. 8"
- ② Cement pad? ☒ Yes No
- ③ Solid pipe: Type PVC Length 59.1' Dia. 4"
- ④ Seal type: HIGH SOLIDS BENTONITE GROUT
- ⑤ Filter pack: 10-20 SILICA SAND
- ⑥ Well screen: Type PVC Length 5' Dia. 4"
 Slot size 0.010
- ⑦ Sand type: #60 SILICA

Dimensions:

- △ A Total depth of boring 63.0 ft
- △ B Total depth of finished well 62.5 ft
- △ C Sand: Interval 53-54 ft
- △ D Filter pack: Interval 54-63 ft
- △ E Seal: Interval 15-53 ft
- △ F Bentonite chip seal: Interval 3-15 ft
- △ G Height of stick-up 2.1 ft
- △ H Borehole diameter 8.0 in
- △ I Length of endcap 0.5 ft

WME-3

MONITORING WELL CONSTRUCTION INFORMATION SHEET



Project HOMESTAKE GRP
 Well number WME-3
 Date 06-28-2018
 Drilling company CASCADE
 Location LTP SAND
 Date drilled 06-15-2018
 Date completed 06-17-2018

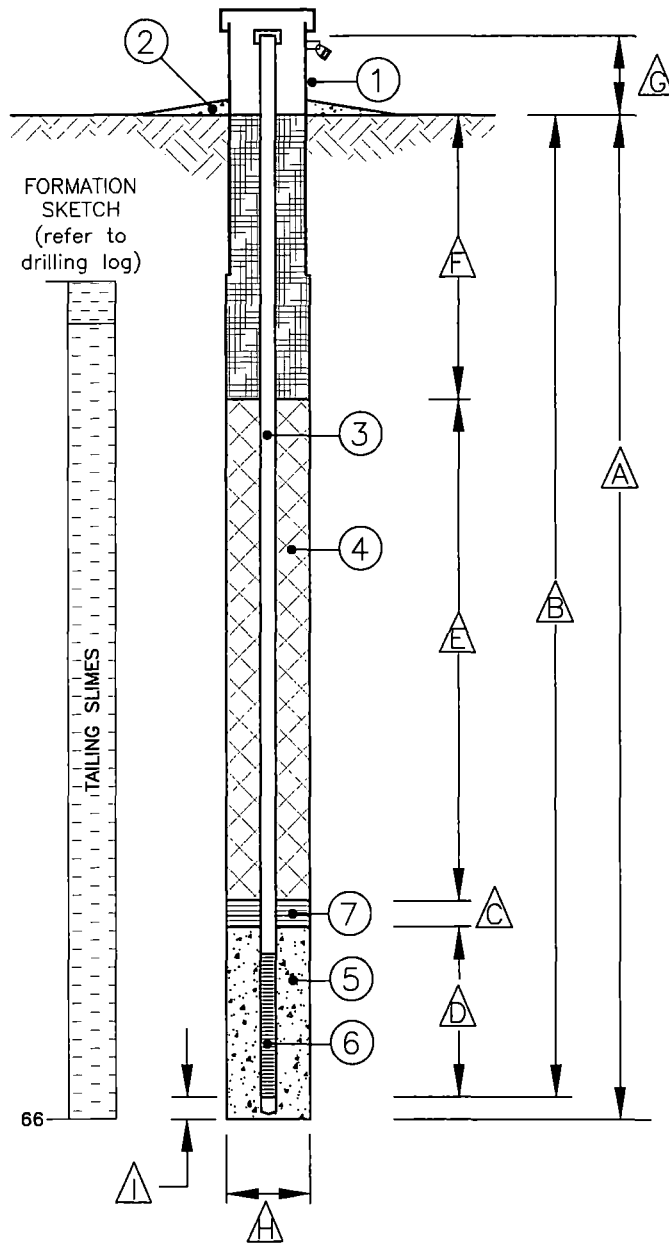
Materials:

- ① Protective casing? ☒ Yes ☐ No
 Height above ground 2.5 ft
 Type STEEL Length 5' Dia. 8"
- ② Cement pad? ☒ Yes ☐ No
- ③ Solid pipe: Type PVC Length 67.15' Dia. 4"
- ④ Seal type: HIGH SOLIDS BENTONITE GROUT
- ⑤ Filter pack: 10-20 SILICA SAND
- ⑥ Well screen: Type PVC Length 5' Dia. 4"
 Slot size 0.010
- ⑦ Sand type: #60 SILICA

Dimensions:

- △ A Total depth of boring 71.0 ft
- △ B Total depth of finished well 70.5 ft
- △ C Sand: Interval 61.5-62.5 ft
- △ D Filter pack: Interval 62.5-70.5 ft
- △ E Seal: Interval 15-61.5 ft
- △ F Bentonite chip seal: Interval 3-15 ft
- △ G Height of stick-up 2.15 ft
- △ H Borehole diameter 8.0 in
- △ I Length of endcap 0.5 ft

WME-4 MONITORING WELL CONSTRUCTION INFORMATION SHEET



Project HOMESTAKE GRP
 Well number WME-4
 Date 06-28-2018
 Drilling company CASCADE
 Location LTP SLIME
 Date drilled 06-17-2018
 Date completed 06-17-2018

Materials:

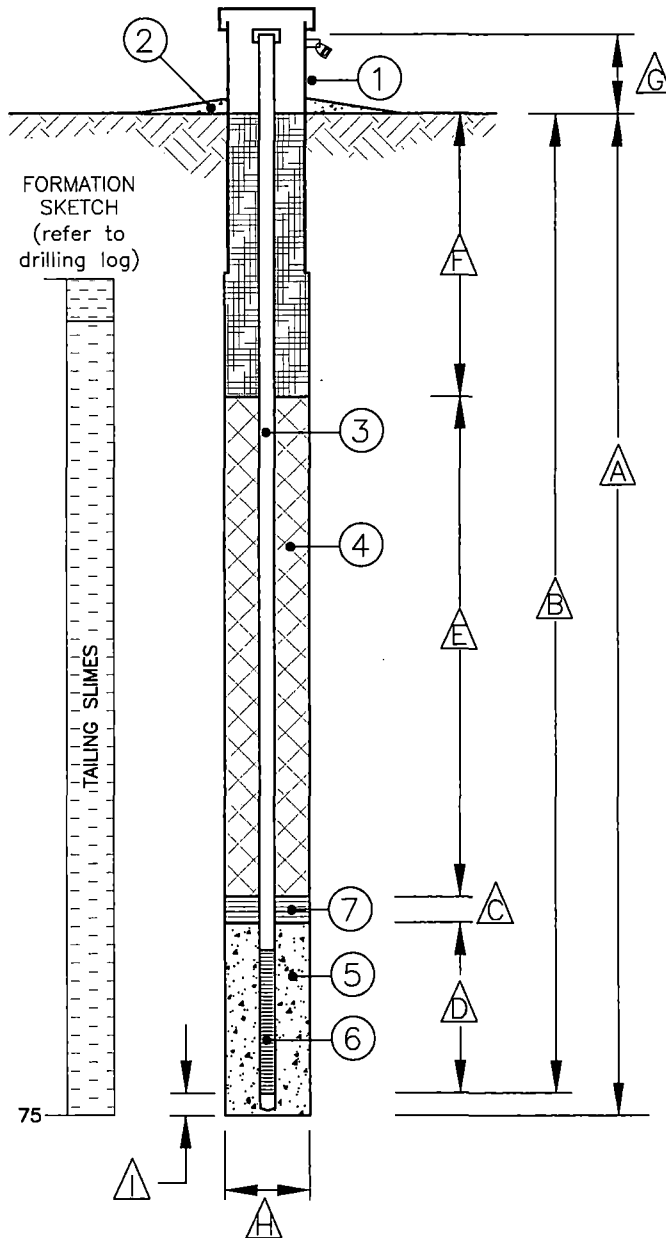
- ① Protective casing? ☒ Yes No
 Height above ground 2.5 ft
 Type STEEL Length 5' Dia. 8"
- ② Cement pad? ☒ Yes No
- ③ Solid pipe: Type PVC Length 62.1' Dia. 4"
- ④ Seal type: HIGH SOLIDS BENTONITE GROUT
- ⑤ Filter pack: 10-20 SILICA SAND
- ⑥ Well screen: Type PVC Length 5' Dia. 4"
 Slot size 0.010
- ⑦ Sand type: #60 SILICA

Dimensions:

- △ A Total depth of boring 66.0 ft
- △ B Total depth of finished well 65.5 ft
- △ C Sand: Interval 56-57 ft
- △ D Filter pack: Interval 57-66 ft
- △ E Seal: Interval 15-56 ft
- △ F Bentonite chip seal: Interval 3-15 ft
- △ G Height of stick-up 2.1 ft
- △ H Borehole diameter 8.0 in
- △ I Length of endcap 0.5 ft

WME-5

MONITORING WELL CONSTRUCTION INFORMATION SHEET



Project HOMESTAKE GRP
 Well number WME-5
 Date 06-28-2018
 Drilling company CASCADE
 Location LTP SLIME
 Date drilled 06-18-2018
 Date completed 06-18-2018

Materials:

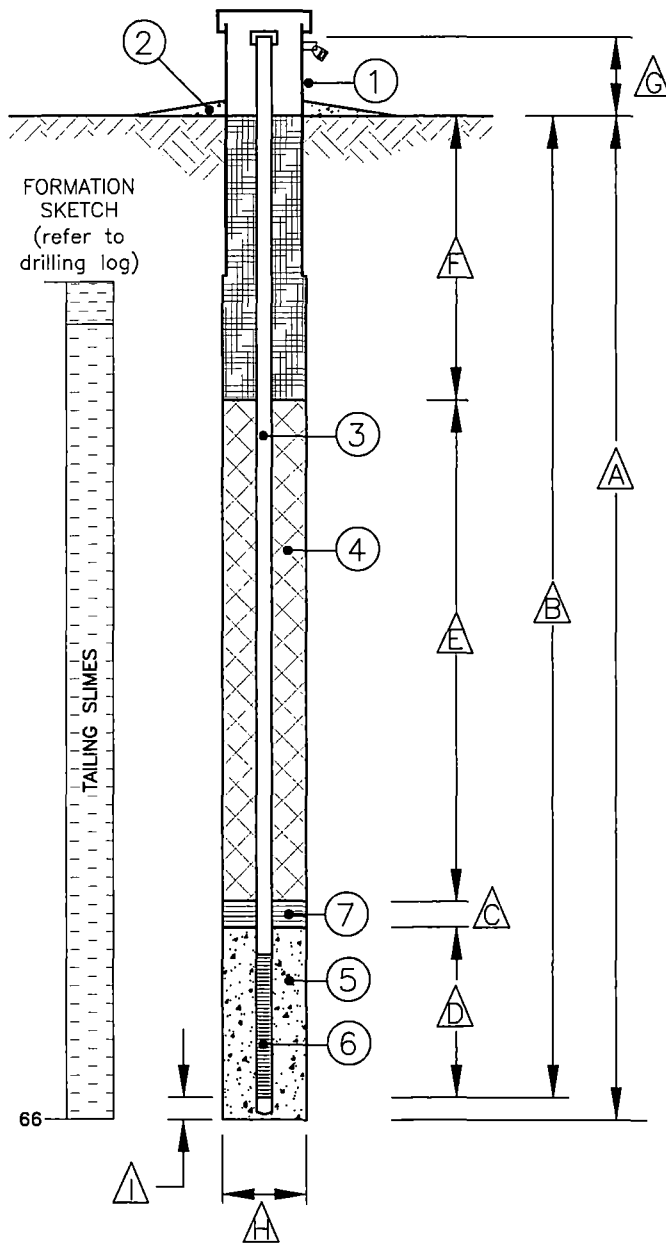
- ① Protective casing? ☒ Yes ☐ No
Height above ground 2.5 ft
Type STEEL Length 5' Dia. 8"
- ② Cement pad? ☒ Yes ☐ No
- ③ Solid pipe: Type PVC Length 71.82' Dia. 4"
- ④ Seal type: HIGH SOLIDS BENTONITE GROUT
- ⑤ Filter pack: 10-20 SILICA SAND
- ⑥ Well screen: Type PVC Length 5' Dia. 4"
Slot size 0.010
- ⑦ Sand type: #60 SILICA

Dimensions:

- △ A Total depth of boring 75.0 ft
- △ B Total depth of finished well 75.0 ft
- △ C Sand: Interval 65.5-66.5 ft
- △ D Filter pack: Interval 66.5-75 ft
- △ E Seal: Interval 17-65.5 ft
- △ F Bentonite chip seal: Interval 3-17 ft
- △ G Height of stick-up 2.32 ft
- △ H Borehole diameter 8.0 in
- △ I Length of endcap 0.5 ft

WME-6

MONITORING WELL CONSTRUCTION INFORMATION SHEET



Project HOMESTAKE GRP
 Well number WME-6
 Date 06-28-2018
 Drilling company CASCADE
 Location LTP SLIME
 Date drilled 06-19-2018
 Date completed 06-19-2018

Materials:

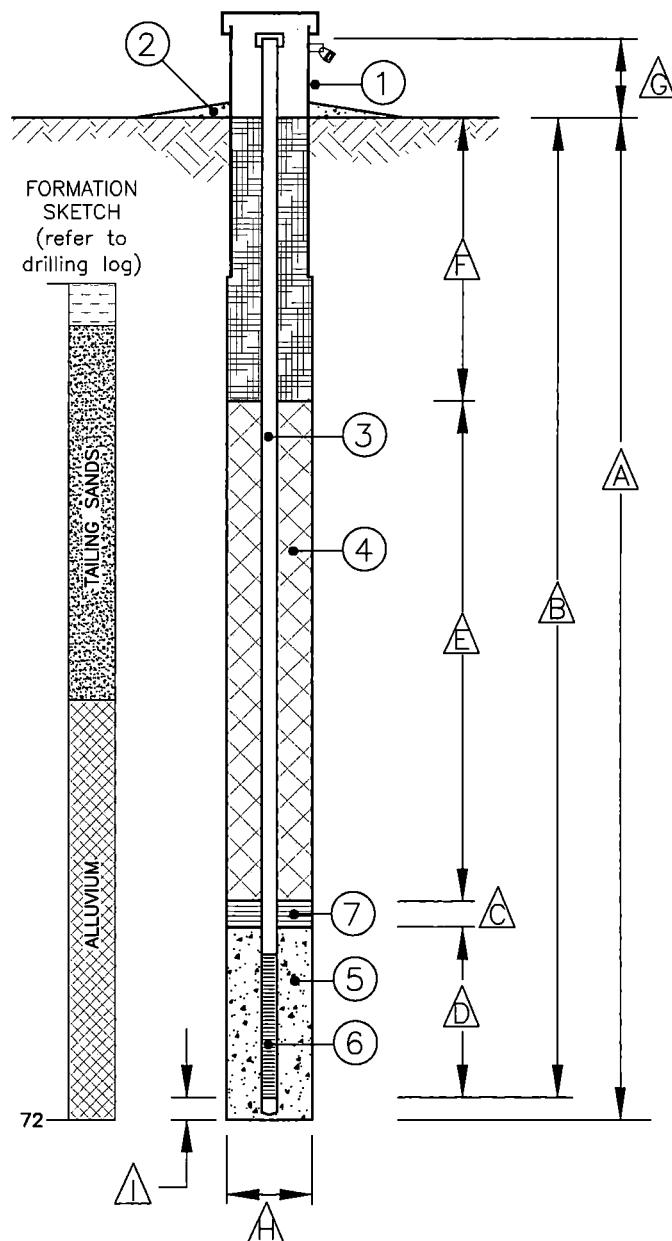
- ① Protective casing? ☒ Yes No
 Height above ground 2.5 ft
 Type STEEL Length 5' Dia. 8"
- ② Cement pad? ☒ Yes No
- ③ Solid pipe: Type PVC Length 61.75' Dia. 4"
- ④ Seal type: HIGH SOLIDS BENTONITE GROUT
- ⑤ Filter pack: 10-20 SILICA SAND
- ⑥ Well screen: Type PVC Length 5' Dia. 4"
 Slot size 0.010
- ⑦ Sand type: #60 SILICA

Dimensions:

- △ A Total depth of boring 66.0 ft
- △ B Total depth of finished well 65.5 ft
- △ C Sand: Interval 55.5-56.5 ft
- △ D Filter pack: Interval 56.5-65.5 ft
- △ E Seal: Interval 15-55.5 ft
- △ F Bentonite chip seal: Interval 3-15 ft
- △ G Height of stick-up 1.75 ft
- △ H Borehole diameter 8.0 in
- △ I Length of endcap 0.5 ft

WME-9

MONITORING WELL CONSTRUCTION INFORMATION SHEET



Project HOMESTAKE GRP
 Well number WME-9
 Date 06-28-2018
 Drilling company CASCADE
 Location STP SAND
 Date drilled 06-19-2018
 Date completed 06-20-2018

Materials:

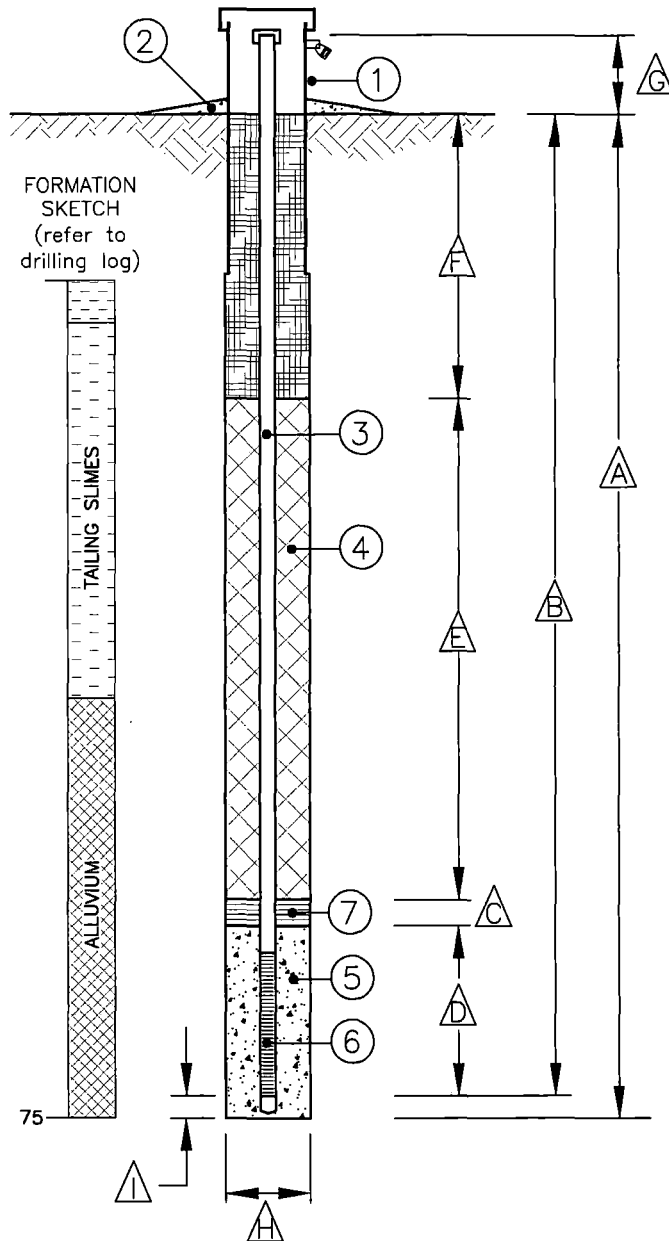
- ① Protective casing? ☒ Yes No
Height above ground 2.5 ft
Type STEEL Length 5' Dia. 8"
- ② Cement pad? ☒ Yes No
- ③ Solid pipe: Type PVC Length 67.7' Dia. 4"
- ④ Seal type: HIGH SOLIDS BENTONITE GROUT
- ⑤ Filter pack: 10-20 SILICA SAND
- ⑥ Well screen: Type PVC Length 5' Dia. 4"
Slot size 0.010
- ⑦ Sand type: #60 SILICA

Dimensions:

- △ A Total depth of boring 72.0 ft
- △ B Total depth of finished well 71.5 ft
- △ C Sand: Interval 63-64 ft
- △ D Filter pack: Interval 64-72 ft
- △ E Seal: Interval 16-63 ft
- △ F Bentonite chip seal: Interval 3-16 ft
- △ G Height of stick-up 1.7 ft
- △ H Borehole diameter 8.0 in
- △ I Length of endcap 0.5 ft

WME-10

MONITORING WELL CONSTRUCTION INFORMATION SHEET



Project HOMESTAKE GRP
 Well number WME-10
 Date 06-28-2018
 Drilling company CASCADE
 Location STP SLIME
 Date drilled 06-20-2018
 Date completed 06-21-2018

Materials:

- ① Protective casing? ☒ Yes No
 Height above ground 2.5 ft
 Type STEEL Length 5' Dia. 8"
- ② Cement pad? ☒ Yes No
- ③ Solid pipe: Type PVC Length 71.2' Dia. 4"
- ④ Seal type: HIGH SOLIDS BENTONITE GROUT
- ⑤ Filter pack: 10-20 SILICA SAND
- ⑥ Well screen: Type PVC Length 5' Dia. 4"
 Slot size 0.010
- ⑦ Sand type: #60 SILICA

Dimensions:

- △ A Total depth of boring 75.0 ft
- △ B Total depth of finished well 75.0 ft
- △ C Sand: Interval 65.5-66.5 ft
- △ D Filter pack: Interval 66.5-75 ft
- △ E Seal: Interval 15-65.5 ft
- △ F Bentonite chip seal: Interval 3-15 ft
- △ G Height of stick-up 1.7 ft
- △ H Borehole diameter 8.0 in
- △ I Length of endcap 0.5 ft

Appendix B

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CONTENTS

[illegible]

THURSDAY JANUARY 4, 2018

0900 ARRIVE @ 8:30

1103 @ WME-9 - BACKGROUND
~~N 40° 32' 11.5"~~ OLD GPS
~~W 105° 01' 10.3"~~ READING.

1116 WME-13 - LTP SAND
 ALLUVIAL BORING.
 N 35° 14' 25.4"
 W 107° 51' 56.5"

1122 WME-12 - ALLUVIAL BORING.
 N 35° 14' 30.1"
 W 107° 52' 16.0"

1137 WME-11 ALLUVIAL BORING
 N 35° 14' 29.2"
 W 107° 52' 46.8"

1147 WME-10 ALLUVIAL BORING
 N. 35° 14' 24.2"
 W 107° 53' 21.1"

THURSDAY JANUARY 4, 2018

1210 WME-14 ALLUVIAL BORING.
 N 35° 14' 06.1"
 W 107° 52' 09.5"

1225 WME-15 ALLUVIAL BORING.
 N 35° 12' 51.3"
 W 107° 51' 50.7"

1242 WME-1 LTP - SAND
 N 35° 14' 34.1"
 W 107° 52' 10.3"

1249 WME-4 LTP - SLIME
 N 35° 14' 37.2"
 W 107° 52' 04.2"

1254 WME-5 LTP - SLIME
 N 35° 14' 38.2"
 W 107° 51' 50.1"

1304 WME-6 LTP - SLIME
 N. 35° 14' 39.1"
 W 107° 51' 40.1"

THURSDAY JANUARY 4, 2018

1312 WME-3 LTP-SANDS
N. $35^{\circ} 14' 37.5''$
W $107^{\circ} 51' 29.6''$

1318 WME-2 LTP-SAND
N $35^{\circ} 14' 43.6''$
W $107^{\circ} 51' 54.5''$

1328 WME-7 STP-SAND
N $35^{\circ} 14' 06.4''$
W $107^{\circ} 51' 37.7''$

1333 WME-8 STP-SLIME
N $35^{\circ} 14' 07.4''$
~~N~~ $107^{\circ} 51' 39.5''$

1348 WME-9 - BACKGROUND
N $35^{\circ} 14' 58.5''$
W $107^{\circ} 51' 45.2''$

DRAFT

D.T.W.
50
50
55
30
48
38

$$\begin{array}{r} 50 \\ 41 \\ \hline 40 \\ 45 \\ \hline 69 \\ 8 \\ \hline 31 \\ 41 \\ \hline 74 \end{array}$$

TD	
62	1
62	2
67	3
62	4
70	5
70	6

71	SAT.
76	THUR
	60
	38
	<u>20</u>
	50
	<u>38</u>
	64
	X

MMVF -
COLUMN

Location	Description	ABA-PH-CEC-TOC	XRD	HCT	TESSIER-6-STEP	SEM
WME-1	STP Sands	X	X			
WME-2	STP Sands	X	X	X	X	X
WME-3	STP Sands	X	X		X	
WME-4	STP Simes	X	X			
WME-5	STP Simes	X	X	X	X	X
WME-6	STP Simes	X	X		X	
WME-7	Perched Alluvium	X	X		X	
WME-7	Vadose Alluvium	X	X		X	
WME-8	Perched Alluvium	X	X			X
WME-8	Vadose Alluvium	X	X			
WME-9	STP Sands	X	X	X	X	
WME-10	STP Simes	X	X	X	X	X
WME-11	Alluvium	X	X		X	
WME-12	Alluvium	X	X			
WME-13	Alluvium	X	X		X	X
WME-14	Alluvium	X	X		X	
WME-15	Alluvium	X	X			
WME-16	Alluvium	X	X		X	X
WME-17	Alluvium	X	X			
Total		19	19	4	12	6

WEDNESDAY JUNE 13, 2018
 HOMESTAKE GEOCHEM DRILLING.
 CASCADE DRILLING.

DRILLING CREW:

ALVIN ANDERSON - DRIVER
 PAUL DICKINSON - HELPER
 TOM DEVICK - HELPER

0800 RADIATION SAFETY TRAINING
 0930 SIGN OUT RAD BADGE
 0940 UNLOAD DRILLING EQUIPMENT
 IN LAYDOWN AREA.

GATE CODE: 2986

1120 FILL WATER TRUCK.
 1210 RIG @ WME-1
 1345 TOWER UP ON WME-1
 1410 SPUD IN WME-1 (LTP SAND)
 0'-4' STIFF CLAY. DRY.
 REDDISH BROWN.

1425 @ 15'
 4'-15' SAND. LOOSE. DRY.
 LIGHT BROWN.

1530 @ 25' SAND. LOOSE. DRY.
 LIGHT BROWN TO LT. GRAY.
 STRONG REACTION TO
 10% HCl.

THURSDAY JUNE 14, 2018
 HOMESTAKE GEOCHEM

0615 ARRIVE @ SITE

0700 SAFETY MTG.

- LIGHTNING POLICY
- SHIFT SCHEDULE
- SAMPLE HANDLING

0715 PREPARE CUTTING TORCH.
 NEED TO REMOVE COUPLER
 FROM DRILL HEAD.

0750 DRILL 8" CORE FROM 25'

0800 @ 35'

25'-35': SAND w/ SOME
 CLAY LENSES. LOOSE.

WELL SORTED FINE SAND.

LIGHT BROWN. SOFT CLAY.

SMALL LENSES. GRAY.

0805 PUSH 10" CASING TO
 25'.

0808 DRILL 8" FROM 35'

0830 @ 45'

35'-45': CLAYEY SAND. SOFT.
 LOOSE. WELL SORTED FINE

SAND. MED. DARK GRAY.

WET! MASSIVE
 STRUCTURE.
 NO LENSES.

STRONG
 HCl

THURSDAY JUNE 14, 2018
HOMESTAKE GEOCHEM DRILLING.

0840 CLEAN OUT BORE HOLE TO 45'

0900 @ 55' TD.

0920 COLLECT SAMPLE WME-1
FROM 54'-55'.

0922 FILL COLUMN WME-1
FLUSH w/ NITROGEN @ 3 L/min
FOR 5 MINUTES.

45'-55': SAME AS ABOVE
SOME MED-STIFF
CLAY. MED-DARK
GRAY. WET.
MILD REACTION TO
10% HCL.

0930 PUSH 10" CASING TO 45'

0940 CLEAN OUT BOREHOLE TO 55'

1020 CLEAN TO 54'

PREPARE TO SET WELL.

1030 PVC COUNT

5' SCREEN: 1

10' BLANK: ~~THH~~ 1

THURSDAY JUNE 14, 2018
HOMESTAKE GEOCHEM WELLS

WME-2, (LTP SAND)

1050 WELL SET TO 55' BGS.

ADD SAND FILTER PACK.

1100 FILTER PACK SET TO
47' BGS.

1120 SCAN OUT... GO TO LUNCH.

1210 RETURN TO SITE.

PREPARE TO GROUT WME-1

1300 ALL CASING OUT OF HOLE.

1320 GROUT COMPLETE

MOBILIZE TO WME-2

1340 @ WME-2

1410 SPUD IN WME-10

1415 0'-4': CLAY. DENSE. DRY.
BROWNISH RED.

1425 4'-15'

SAND. LOOSE. WELL SORTED

FINE SAND. DRY. LIGHT

BROWN. STRONG REACTION

TO 10% HCL.

1430 10" CASING TO 15'

CLEAN OUT w/ 8" CORE.

TO 15'

THURSDAY JUNE 14, 2018
HOMESTAKE GEOCHEM WELLS.
WME-2, (LTP SAND)

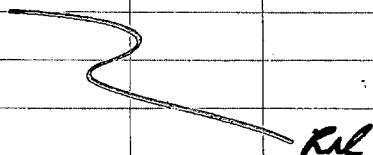
1440 15-25: SAME AS ABOVE.
1445 25-35: SAND w/ TRACE
CLAY LENSES. LOOSE
FINE. WELL SORTED.
MED. BROWN AND RED.
10% CLAY. SOFT
INTERBEDDED LENSES.
DRY. MED. GRAY.

1448 ADVANCE 10" CASING
TO 25'... CLEAN OUT TO 35'

1510 35-45: SAME AS ABOVE.
NO RED. MED GRAY

1530 STORM SHUTDOWN!

1550 LEAVE SITE



RL

FRIDAY JUNE 15, 20
HOMESTAKE GEOCHEM WELLS

0530 ARRIVE C. SITE
0540 SAFETY MEETING.
0550 LOAD WELL SUPPLIES
IN YARD.

0615 @ WME-1. INSTALL
MONUMENT.

ADD 2' TO 55'
57' TOTAL PVC.

0710 WME-1.
DTW = 53.25' T.D.C.
T.D. = 57.60' T.O.C.

0715 @ WME-2
45-55': SAND w/ SOME
CLAY. ~20%. LOOSE.
WELL SORTED FINE SAND.
SOME CLAY STRINKERS.
WEAK - NO REACTION w/
10% HCl. MED GRAY.
MOIST.

FRIDAY JUNE 15, 2018
 HOMESTAKE GEOCHEM WELLS
 WME-2 (LTP SAND)

0740 SAMPLE 62'-57' in

BARREL.

WAIT TO TAKE WATER
 LEVEL.

0800 DTW = 48' ~~FB~~ BGS

0805 NO SAMPLE IN CORE
 BARREL. TRIP BACK IN.

0815 COLLECT WME-2 61'-62'

COLLECT WME-2 COLUMN

56'-61'

55'-62': SAME AS ABOVE.

WET.

0820 PURGE WME-2 COLUMN
 w/ NITROGEN

0821 CLEAN OUT HOLE.

0855 HOLE CLEAN/OPEN TO 62' BGS.

0900 PVC COUNT - WME-2

SCREEN 5' : 1

BLANK 10' : 141

T.D. = 62' BGS.

0940 SAND TO 54' BGS

FINE SAND 54'-58'

FRIDAY JUNE 15, 2018
 HOMESTAKE GEOCHEM WELLS
 WME-2 + WME-3

1030 HIGH SOLIDS BENTONITE

INSTALLED TO 15' BGS

1031 DEMOBE/MOBILIZE TO
 WME-3

1115 @ WME-3

SCAN OUT FOR LUNCH.

1200 SET UP ON WME-3

1230 0'-4' : CLAY. HARD.

DRY. REDDISH BROWN.

1245 4'-15' : SAND. LOOSE.

WELL SORTED. FINE.

DRY. MED. RED BROWN.

1315 15'-25' : CLAY. STIFF/HARD.

DRY. STRONG REACTION

TO 10% HCl. MED. BROWN.

1335 25'-33' SAME AS ABOVE.

33'-35' SAND. LOOSE. DRY.

WELL SORTED. FINE.

VERY LIGHT BROWN.

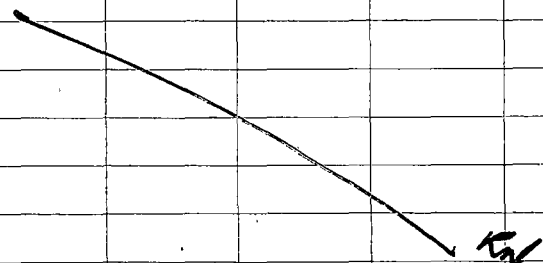
STRONG Rxn TO 10% HCl.

1340 ADD 10' 10" CASING.

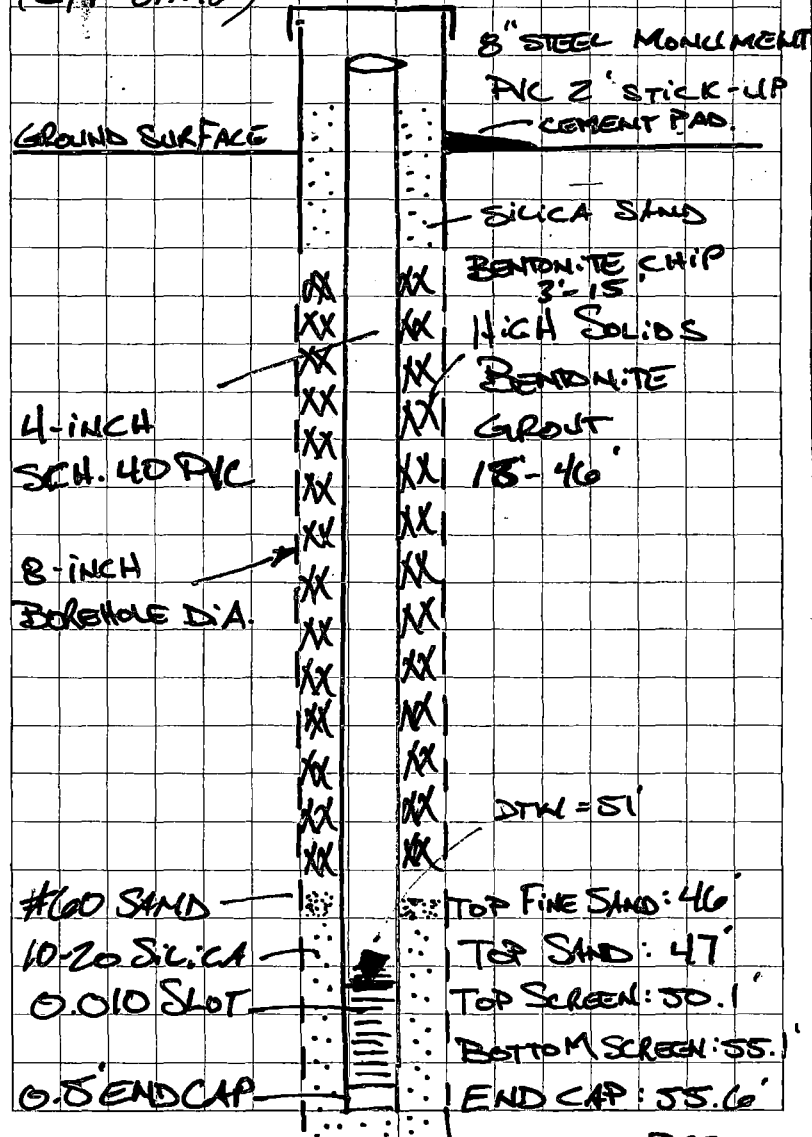
1343 TRIP IN w/ 8" CORE BARREL

FRIDAY JUNE 15, 2018
HOMESTAKE GEOCHEM WELLS
WME-3 (LTP SAND)

- 1350 HOLE CLEAN TO 35' BGS.
1400 35'-45': SAME AS ABOVE.
1402 ADD 10' 10" CASING.
1410 HOLE CLEAN TO 45' BGS.
1500 COLLECT COLUMN WME-3
65'-61'
SAND w/ SOME CLAY.
LOOSE. FINE. WALSARD.
20% CLAY. SOFT. WET.
MEDIUM GRAY.
1505 DTW IN WME-3 = ~~50~~ 51' BGS.
1530 OVERDRILL TO 67'
1540 SIGN OUT



WME-1 COMPLETION (LTP SAND)



N.T.S.

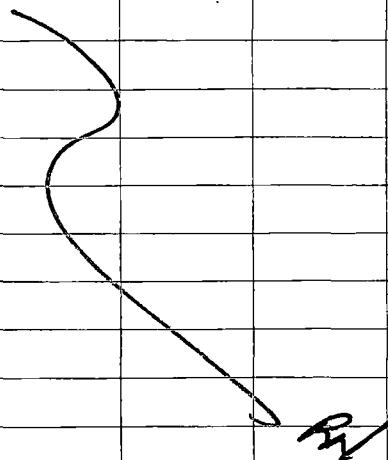
SATURDAY JUNE 16, 2018
HOMESTAKE ~~COCKROACH~~ WELLS

0530 @ BACK GATE

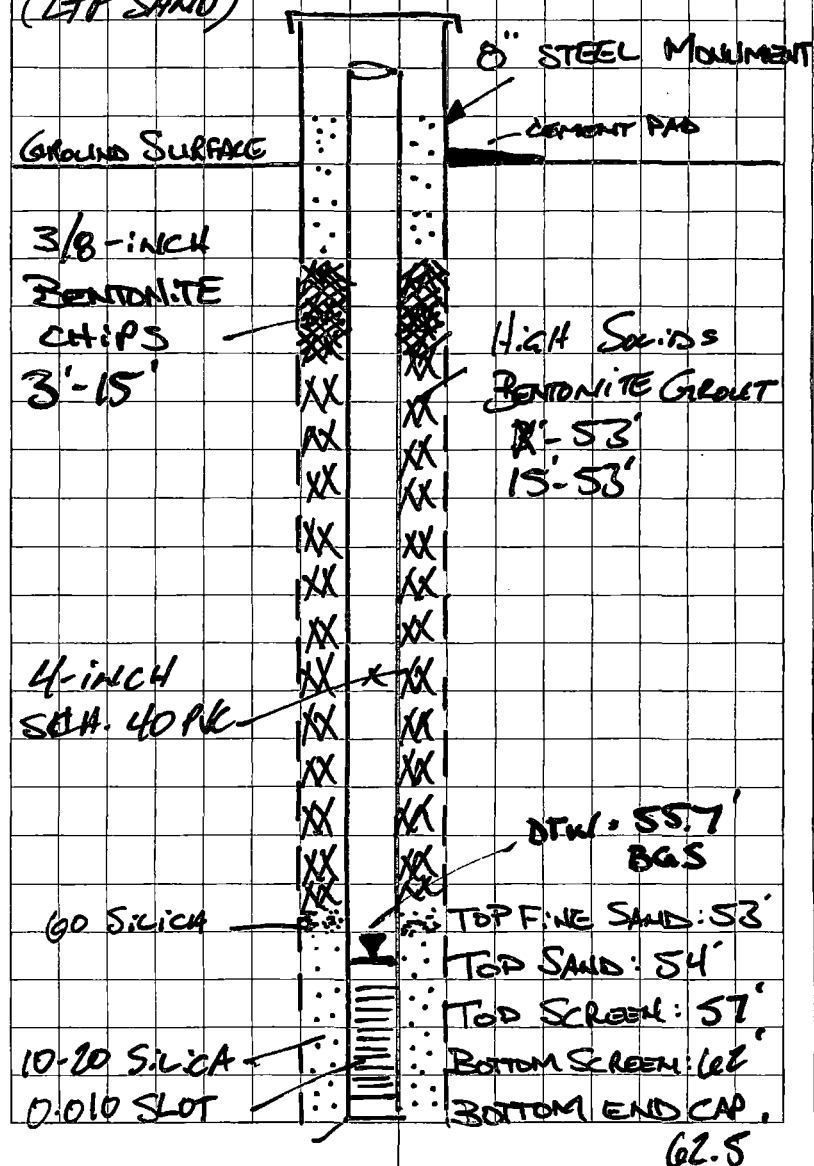
WEATHER: RAIN!

FORECAST: RAIN.

NOTE: TOO MUDDY TO
WORK SAFELY.
DECIDE TO CALL A
REST DAY.



WME-2 COMPLETION (LTP SAND)



SUNDAY JUNE 17, 2018
 HOMESTAKE GEOCHEM WELLS
 * HAPPY FATHER'S DAY *

0600 STILL WATER ON GROUND
 WAIT TO START.

0700 @ BACK GATE. CODE: 2986

0800 @ YARD. MEET w/ JASON
 * WILL LEAVE BACK GATE OPEN.

0820 SAFETY MEETING.

- NEW PPE TYRES + BOOTS CHANGE.
- NO CROSS CONTAMINATION!
- CLEAN GLOVES FOR WELL CONST.

WEATHER: 70°F. PARTLY CLOUDY.
 NO WIND.

0830 WME-3 DTH = 57' BGS
 TD = 67'.

OVERDRILL TO 70'.
 0900 67-70': SAME AS ABOVE
 WET.

0902 TAG HOLE TD = 70' BGS.
 PREPARE TO SET WELL

SUNDAY JUNE 17, 2018
WME-3 & WME-4

PVC COUNT: 4" SCH. 40

5' SCREEN: 1

10' BLANK: 11111

0930 WME-3 SET TO 70' BGS.

1000 SAND IN TO 62.5' BGS.

FINE SAND TO 61.5' BGS.

1030 HIGH SOLIDS BENDONITE
 GROUT IN TO 15' BGS.

1051 MOBILIZE TO WME-4.

1135 @ WME-4.

1145 LUNCH BREAK.

1225 GO TO YARD FOR WELL SUPPLIES.

1240 RETURN TO WME-4
 SET-UP RIG.

1300 SPUD IN.

1305 0'-4': CLAY. STIFF/HARD.

DRY. MED. RED BROWN.

1315 4'-15': SAND. LOOSE. DRY.

WELL SORTED. FINE.

LIGHT YELLOWISH BROWN.

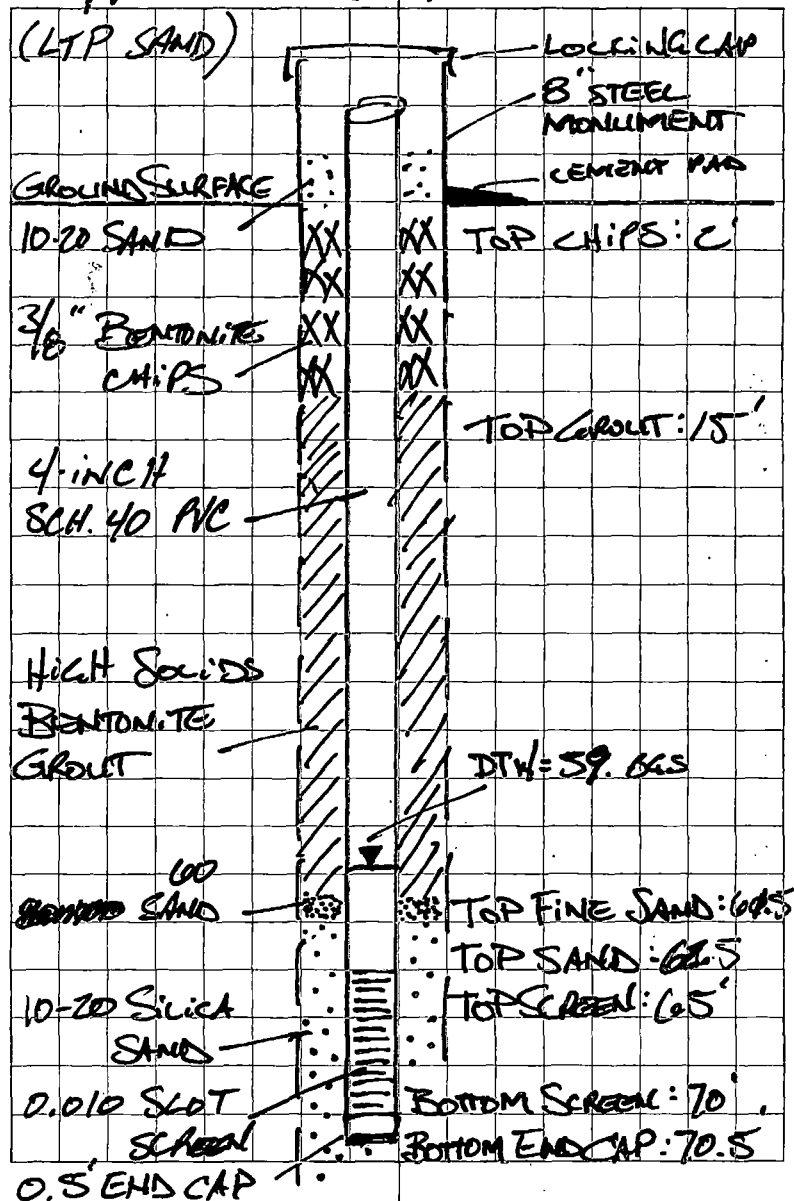
STRONG. RUN TO 10% ICA

SUNDAY JUNE 17, 2018
WME-4 (LTP SLIME)

- 1340 15'-25': CLAY. MED STIFF. ^{10/10}
MOIST. TRACE FINE SAND.
VERY DARK ~~GRAY~~ TO
BLACK. MASSIVE. NO LAYERS.
STRONG ~~WET~~ RUN TO 10% HCl.
- 1350 25'-35' SAME AS ABOVE.
- 1352 ADVANCE 10" CASING TO 25'
- 1415 35'-45' CLAY. MED STIFF-STIFF.
MOIST. NO SAND. MED GRAY.
DARK GRAY. STRONG RUN TO 10%
HCl. SULFUR SMELL.
- 1440 45'-55': SAME AS ABOVE.
WET!
- 1445 ADVANCE 10" CASING TO 45'
- 1455 CLEAN HOLE TO 55'
- 1530 55'-65': SAME AS ABOVE.
- 1530 COLLECT WME-4 @ 65'
FILL WME-4 COLUMN
61'-64'
- 1540 PURGE WME-4 COLUMN
w/ NITROGEN.

WME-3 COMPLETION

(LTP SAND)



SUNDAY JUNE 17, 2018

WME-4 (LTP SLIME)

1500 WME-4 DTW in CORKHOLE
= 50' BGS.

PREPARE TO SET WELL.

1630 HOLE CLEAN TO 65'

1650 WME-4 PVC COUNT

5' SCREEN: 1

10' BLANK: 1111

1700 PVC SET TO 65' BGS.

1731 SAND UP TO 57' BGS

FINE SAND TO 56' BGS

PREPARE TO GROUT.

1805 GROUT IN TO 35' BGS

PULL 10" CASING.

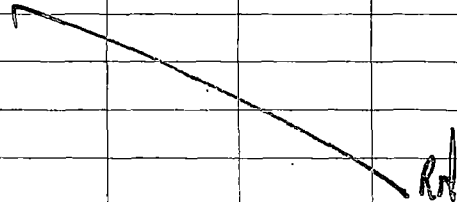
1820 GROUT UP TO 15' BGS

PULL 10" CASING.

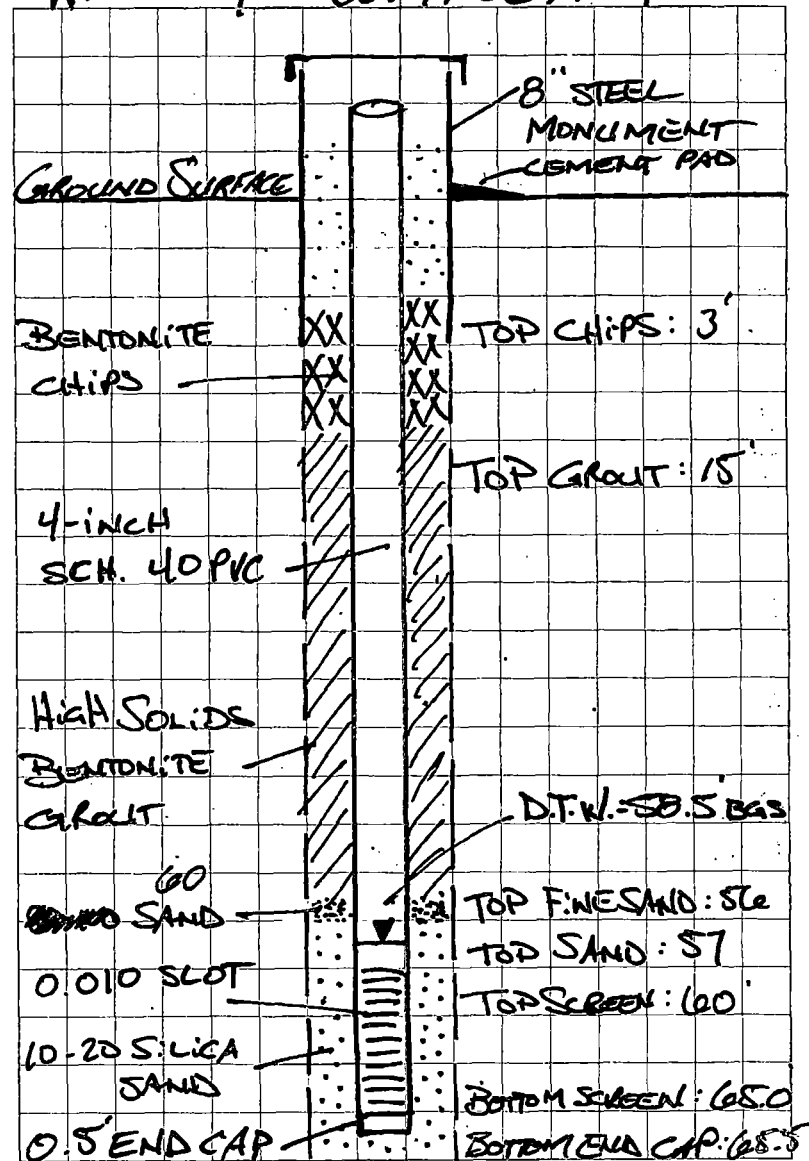
1835 CASING OUT. SHUT DOWN.

1845 SIGN IN BADGE

1855 OFF SITE.



WME-4 COMPLETION



MONDAY JUNE 18, 2018
 HOMESTAKE GEOCHEM WELLS
WME-5 (LTP SLIME)

0530 ARRIVE @ SITE
 * CLEAR LATE DEPARTURE
 PROTOCOL w/ KYLE & BILLY.

0535 SAFETY MEETING
 • PPE / CONTAMINATION
 • SITE CONTROL
 • MOBILIZATION TO WME-5

0545 @ YARD. PICK UP WELL
 SUPPLIES. INVENTORY PIC.
 - MORE TO BE SHIPPED.

0600 SIGN OUT BADGE.

0610 DEMOB / MOBILIZE TO WME-5.
 * DISCUSS BEING MINDFUL
 NOT TO GET CUTTINGS ON
 RIG WHEN MOVING OFF HOLE
 w/ DRILLER / ALLIANCE.

0700 @ WME-5 - FUEL RIG.

0800 SPUD IN 10-INCH CASING.
 0'-3': CLAY. STIFF / HARD. DRY.
 MED. REDDISH BROWN.
 (CAP).

MONDAY JUNE 18, 2018

WATER LEVELS:

		T.D. (G.S.)
WME-1	51.4' BGS	55.5
WME-2	55.7' BGS	62.5
WME-3	59.3' BGS	70.5
WME-4	58.5' BGS	65.5

FEET OF WATER IN WELLS:

		WELL VOLUME
WME-1	= 4.1'	= 2.2 GAL
WME-2	= 6.8'	= 3.6 GAL
WME-3	= 11.2'	= 6.0 GAL
WME-4	= 7.0'	= 3.8 GAL

WME-5

0810 ADD 2ND 10" 10-INCH CASING.

0815 8'-15': SAND w/ TRACE CLAY.

FINE - V. FINE. LOOSE. DRY.

10% SOFT CLAY

REDDISH BROWN. STRONG.

RUN TO 10% HCL.

0818 - CLEAN OUT w/ 8" CORE.

MONDAY JUNE 18, 2018
WME-5 (LTP SLIME)

0820 15'-18': SAME AS ABOVE.

18'-25': CLAY. MED STIFF-SOFT
 SLIGHTLY MOIST. TRACE
 V. FINE SAND. GREENISH-
 GRAY. MOD. RXX TO 10% HCl.

0835 25'-35': CLAY. MED STIFF. MOIST
 MED-DARK GRAY. MOD.
 RXX TO 10% HCl.
NO SULFUR SMELL.

0900 35'-45': SAME AS ABOVE. WET!
 SLIGHT ORGANIC SULFUR
 SMELL. SLIGHT-NO RXX
 w/ 10% HCl.

0905 ADVANCE 10-INCH CASING.

0908 CLEAN OUT TO 45' w/ 8" CORE

0930 NO CUTTINGS 45'-55'.

TAG HOLE C 88'... HOLE NOT
 STAYING OPEN.

ADD "HULA SKIRT" TO AUGER BIT.

0945 - NO RETURNS.

PREPARE TO ADVANCE
 10-INCH CASING.

* FIRST FORMATIONAL ISSUES.

MONDAY JUNE 18, 2018
WME-5 (LTP SLIME)

1010 45'-65': CLAY w/ TRACE
 SAND. MED. STIFF-SOFT.
 MED DARK GRAY. WET.
 NO-SLIGHT RXX TO 10% HCl.

1030 COLLECT WME-5 @ 75'
 COLLECT COLUMN
 70'-74'.
 SAME AS ABOVE.

1035 PURGE COLUMN w/ N.

1110 BREAK FOR LUNCH

1200 RETURN TO WME-5.

1210 HOLE COLLAPSED TO 57'

1215 ADVANCE 10" CASING.

1300 HOLE CLEAN TO 75'

INSTALL PVC.

WME-5 PVC COUNT

5' SLOT SCREEN : 1

10' BLANK : THH 91

1315 PVC IN TO 75' BLK.

74.5'

MONDAY JUNE 18, 2018

WME-5 + WME-6

1320 INSTALL SAND PACK.

1345 SAND TO 71.5' BAG

FINE SAND TO 70.5'

1350 GROUT HOLE.

1500 GROUT TO 17' BAG.

1504 MOBILIZE TO WME-6.

1600 @ WME-6.

1640 SPUD IN WME-6

1645 0-3' CLAY. STIFF/HARD.

DRY. MED. REDDISH BROWN.

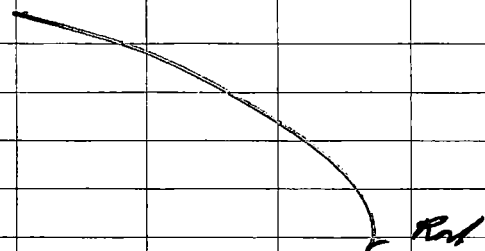
1655 3-10' SAND. LOOSE. 1/2 FINE-FINE.

DRY. NO CLAY. STRONG.

RH TO 10% HCL.

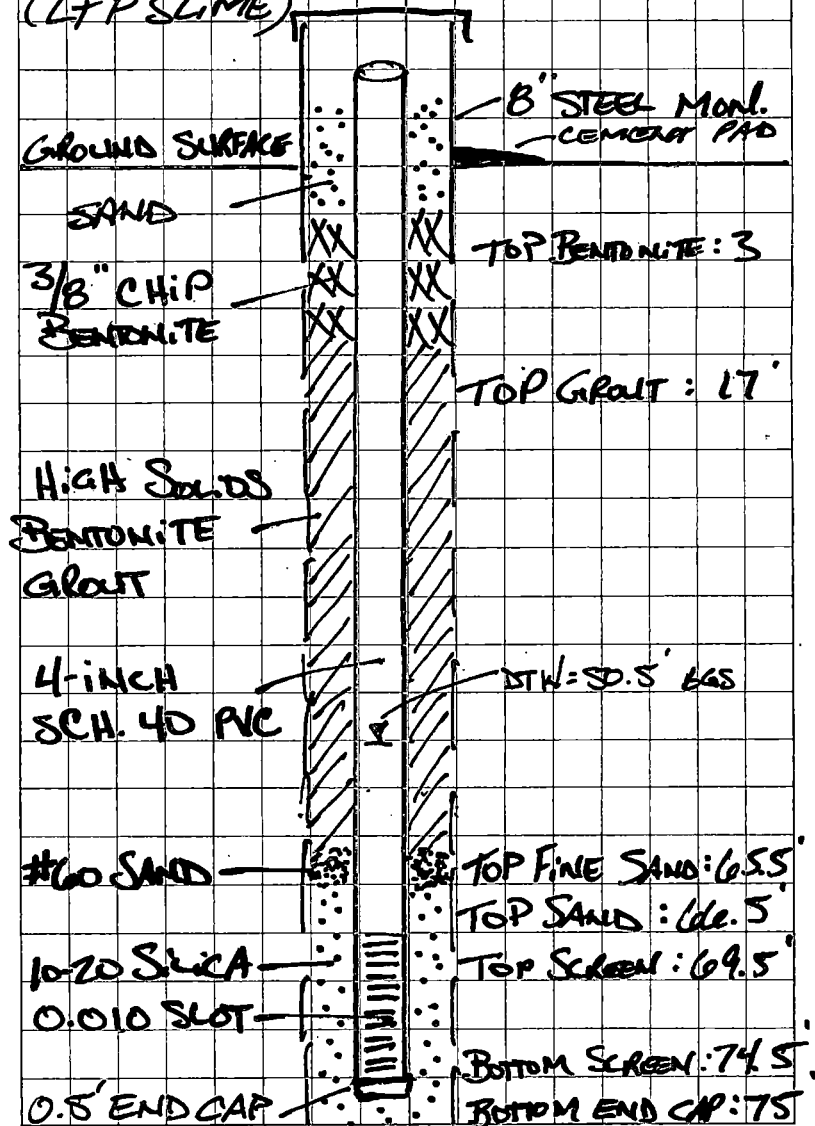
LIGHT BROWN.

1730 LEAVE SITE



WME-5 COMPLETION

(LTP SLIME)



TUESDAY JUNE 19, 2018
 HOMESAKE GEOTHERM WELLS
WME-6 (LTP SLIME)

0525 ARRIVE @ SITE

0535 SAFETY TALK & DAILY TASKS

0600 @ WME-6

0625 10'-15': SAME AS ABOVE

0635 15'-20': SAME AS ABOVE.

(*) 20'-35': CLAY. NO SAND.

MED. DENSE - SOFT.

MOTTLED w/ BLACK

STRINGERS. MED-DARK

GRAY. NONE-MILD RAN

w/ 10% HCl. SULFUR

SMELL. MOIST.

0650 35'-45': CLAY w/ ^{SOME} SAND.

MED DENSE. V. FINE

SAND 20%. NO STRINGERS.

MED GRAY. WET!

NO SULFUR SMELL.

STRONG RAN TO 10% HCl.

0730 COLLECT WME-6
 SAMPLE @ 65'

TUESDAY JUNE 19, 2018
WME-6 (LTP SLIME)

0730 FILL COLUMN #6
 60'-64' BGS.

35'

45'-55': SAME AS ABOVE.

55'-65': SILTY CLAY. MED
 DENSE - DENSE.

30-40% S:LT.

MED. GRAY. THIN

BANDING. NO SULFUR.

WET.

0750 MEASURE WATER IN
 HOLE @ 44' BGS.

PREPARE TO SET WELL
 @ 65'

0800 LOCATE K/ME-9 & WME-10
 ON SMALL TAILINGS PILE

0840 PVC COUNT - K/ME-6
 5' SLOT SCREEN: 1

10' BLANK: THH 1

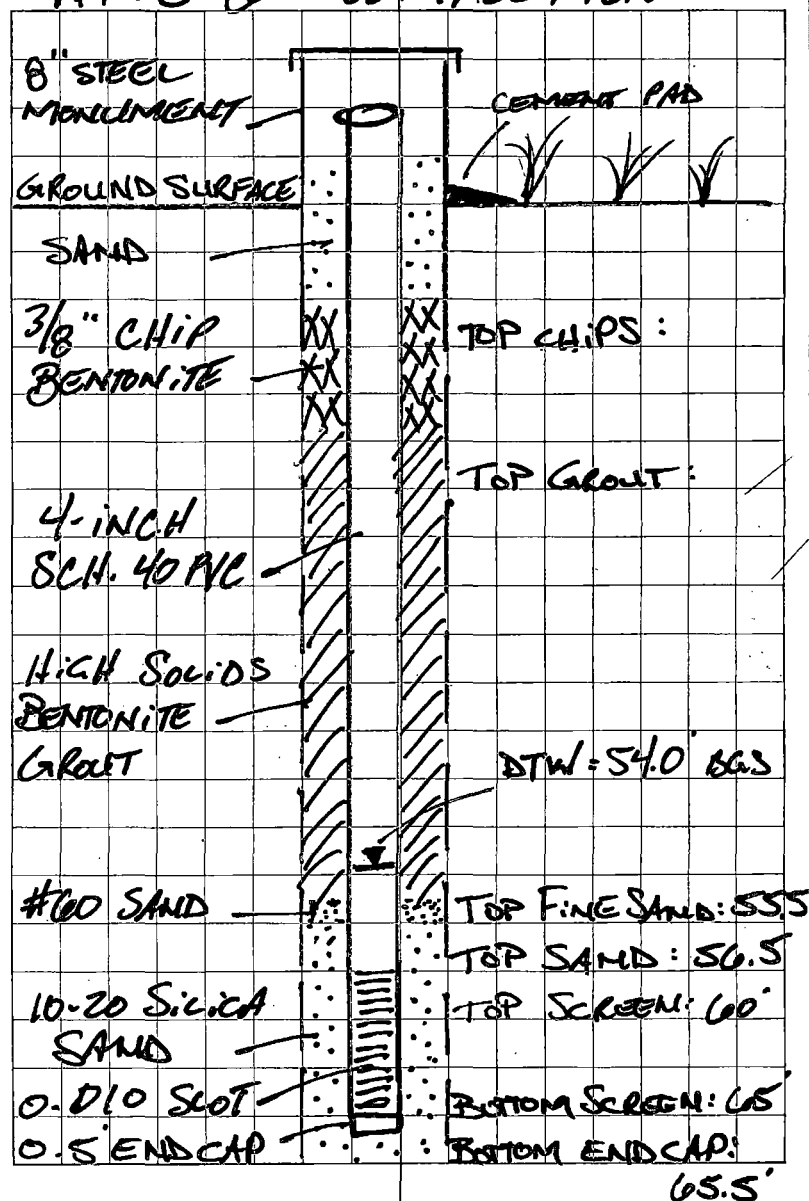
0845 Well Set @ 65'

0850 DEVELOPER ON SITE.

TUESDAY JUNE 19, 2018
WME-6 (LTP SLIME)

- 0930 SAND UP TO 56.5' BGS.
0935 FINE SAND UP TO 55.5' BGS.
0938 PREPARE TO MIX GROUT.
1100 GROUT IN TO 15' BGS
PREPARE TO MOBILIZE
TO WME-9.
1130 LUNCH BREAK - SCAN OUT
1220 RETURN TO LTP.
1250 MOBILIZE TO STP/WME-9
1310 Fill WATER TRUCK.
1350 SET UP ON WME-9 (STP)
1410 0-3' CLAY. STIFF/HARD
DRY. MASSIVE. MED
REDDISH BROWN.
1420 3-15' SILTY CLAY. DRY
MED. STIFF. 40% SILT.
REDDISH BROWN. STRONG
RAN TO 10% HCL.
15.20' CLAY. MOIST. STIFF
DARK GRAY - BLACK.
SILTY SAND. STRONG
RAN TO 10% HCL.

WME-6 COMPLETION



TUESDAY JUNE 19, 2018
WME-9 (STP SAND)

1445 20:30: SILTY SAND w/ TRACE
 CLAY. DRY. LOOSE. V. FINE
 - FINE SAND. 30% SILT
 10% CLAY. LIGHT BROWN.
 STRONG RUN TO 10% HCl.

1445 COLLECT WME-9 FROM
 30'

1530 30'-40': SAND. LOOSE. POORLY
 SORTED. FINE COARSE.
 STRONG RUN TO 10% HCl.
 NO CLAY. YELLOWISH BROWN.
 40-45: SILTY SAND w/ SOME CLAY.
 LOOSE. WELL SORTED. FINE-
 VERY FINE. SLIGHT MOISTURE.
 STRONG RUN TO 10% HCl.
BROWNISH RED!

1600 45-48: SAME.

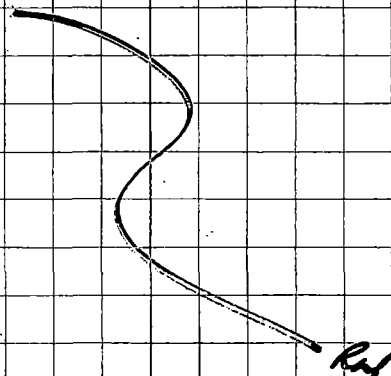
1620 48-55: SAME AS ABOVE.

1645 55-57: CLAYEY SAND. MED STIFF-
 STIFF. V. FINE - FINE. LOOSE.
 STRONG RUN TO 10% HCl.
BROWNISH RED. WET!

TUESDAY JUNE 19, 2018
MWE-9 (STP SAND)

1645 57-60: GRAVELLY SAND.
 LOOSE. V. FINE - V.
 COARSE. 1/4" GRAVEL.
 WELL ROUNDED. POORLY
 SORTED. ~~YELLOWISH~~ REDDISH
 BROWN. WET.

1710 LEAVE SITE



WEDNESDAY JUNE 20, 2018
 GEOCHEM WELL INSTALLATION.
WME-9 (STP SAND)

0525 ON SITE

0535 SAFETY TALK

• UNSECURE LOADS

• LIFT ASSIST.

• TAILINGS CONTAMINATED.

0600 @ WME-6

DTW = 54.0' BGS.

T.D. = 65.5' BGS.

SAT. INT. = 11.5'

WELL VOLUME = 6.21 GALLONS

0630 WME-9

60-65': SAME AS ABOVE.

w/ SOME CLAY 20%

0650 65-72': GRAVEL/ SAND w/

CLAY AND COBBLES.

LOOSE. VERY POORLY SORTED.

ROUNDED GRAVEL & COBBLES

UP TO 3" DIA. BROWNISH

RED. WET!

WEDNESDAY JUNE 20, 2018
WME-9 & WME-10

0653 ADD 10" CASING TO 65'

0700 CASING TO 71'

HOLE OPEN TO 71.5'

PREPARE TO SET WELL

WME-9 PVC COUNT

5' SCOT SCREEN : #

10' BLANK : TTH11

0800 SCREEN/WELL SET TO 71.5'

0910 SAND TO 104' BGS

0913 FINE #40 SAND TO 103'

1040 GRAB UP TO 10' BGS.

MOBILIZE TO WME-10

1055 @ WME-10

(STP SLIME)

1115 LUNCH BREAK

1210 WME-9

DTW = 32.0' BGS.

* POSSIBLE LOGGING ISSUE.

→ SEE WELL LEVEL

6-21-2018

WEDNESDAY JUNE 20, 2018
WME-10 (STP SLIME)

1220 SPUD IN WME-10.

1225 0'-3': CLAY. STIFF/HARD.
DRY. MASSIVE.
REDDISH BROWN.

1240 3'-15' SANDY CLAY. HARD/DENSE.
DRY. 30% V. FINE SAND.
MOSTLY BROWNISH RED.
SOME INTERBEDDED GRAY/BLACK
SANDS STRONG RENEW 10% HCL.

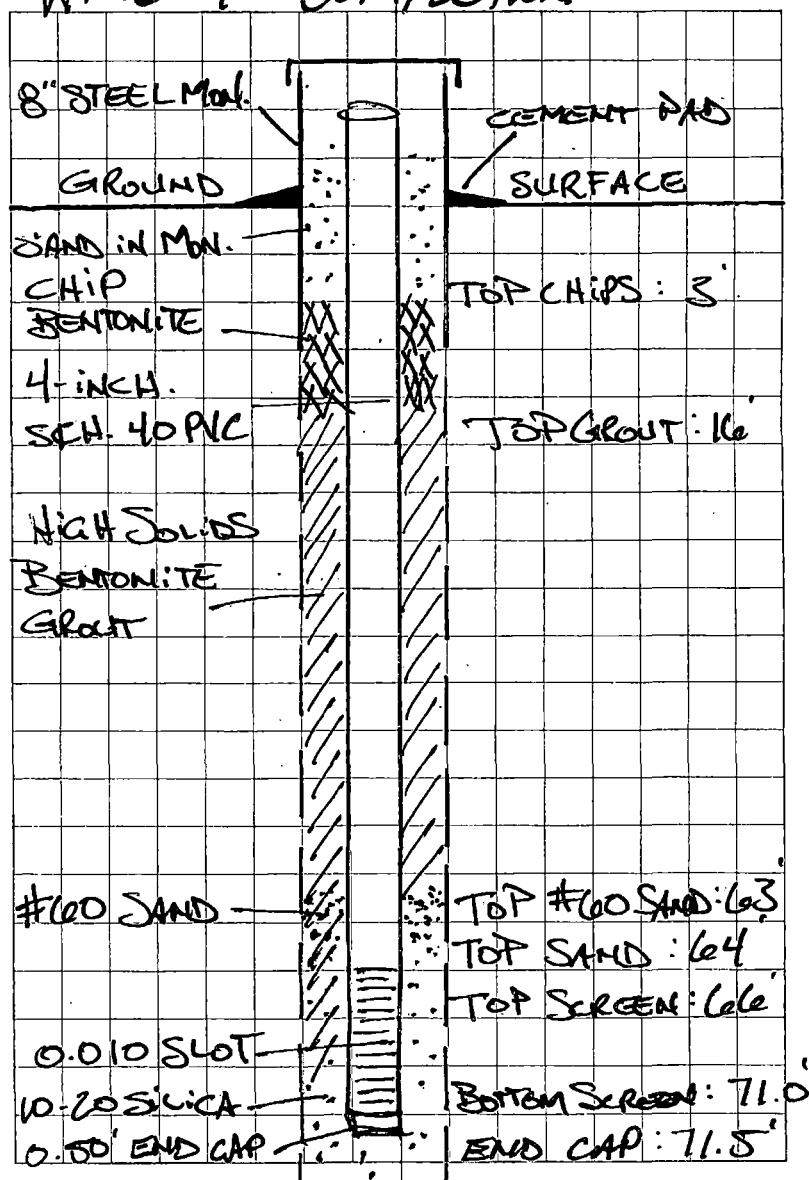
1250 15'-35' SANDY CLAY. DENSE/STIFF
SLIGHT MOISTURE. 30-40%
V. FINE SAND. VERY THIN
BEDDING STRUCTURE.
GRAYS, BLACK, LIGHT GRAY
TAN/BROWN.

1250 COLLECT SAMPLE WME-10
FROM 35'.

1315 35'-45': SAND. LOOSE. WELL SORTED
V. FINE - FINE. V. SLIGHT
MOISTURE. BROWNISH RED.
STRENGTHENED RENEW TO 10% HCL.

1345 45'-55': SAME AS ABOVE.

WME-9 COMPLETION



WEDNESDAY JUNE 20, 2018
WME-10 (STP SLIME)

1405 55'-60': SAME AS ABOVE
60'-65': ALLUVIUM.

GRAVELY SAND w/
TRACE CLAY. LOOSE.

WET. POORLY SORTED
WELL ROUNDED.

10% CLAY. GRAVEL
UP TO 1/4" DIA.

REDDISH BROWN.

1430 65'-75': SAME AS ABOVE.

~~PREPARE TO SET HOLE~~

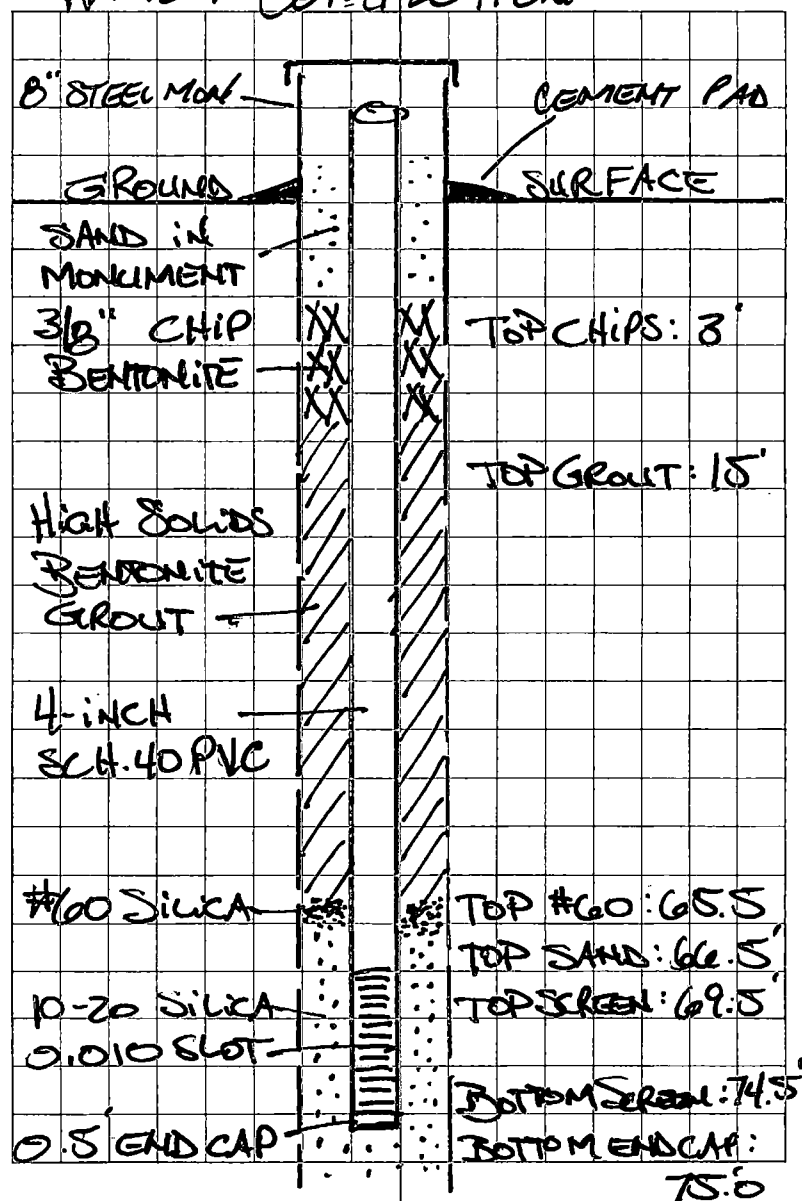
CLEAN HOLE TO 75'.

1600 HOLE CLEAN.

1630 LEAVE SITE



WME-10 COMPLETION



THURSDAY JUNE 21, 2018
HOMESTAKE GEOCHEM KILLS
WME-10

- 0530 ARRIVE @ SITE
0540 SAFETY TALK. & OPS.
- COMPLETE ~~WME~~ WME-10
- MOB TO WME-7
- DEVELOP WME-2
- DEVELOP & SAMPLE WME-344

0605 @ WME-10

0630 WME-10 PVC COUNT

5' SLOT : 1

10' BLANK : HHH11

0640 WME-9 DTKL = 81.4' BGS.

0645 RECON WME-11-17

- 0830 ALL LOCATIONS IDENTIFIED
- KEY FOR #11 ON WALL
- DRILL #17 ON WEEKEND
- NEED ACCESS FOR #15.

0845 10-20 SILICA UP TO
46.5' BGS

T.D. = 75' BGS

BOTTOM SCREEN = 74.5' BGS

THURSDAY JUNE 21, 2018
WME-7 (LTP ALLUVIAL BORING)
THROUGH SANDS

1030 MAST CAP ON WME-7.

1045 BRID IN WME-7.

8-INCH CASING

W/ 6-INCH CORE.

SAMPLE INTERVALS

- PERCHED ALLUVIUM

82'-105'

- VADOSE ALLUVIUM

105'-119'

1115 @ 35' BREAK FOR LUNCH

1120 - PICKUP CHRS (DEV.)

WME-3 SAMPLE

COLLECTED. TAKE TO

LAB TO ALLOW TO

SETTLE.

1215 @ WME-4 DEVELOPMENT.

1320 WME-7 @ 55' - TAILINGS

1335 WME-7 @ 65' - TAILINGS.

1355 @ 75' TAILINGS.

START TO BAG 75'

FOR LOGGING / SAMPLES.

THURSDAY JUNE 21, 2018
WME-7

1430 @ 85' - TAILINGS.

1520 CLEAN OUT TO 85'
 8" CASING TO 85'.

1620 COLUMN B FILLED
 w/ 1.5 GALLONS WATER.

PH = 9.63

SC = 3880

TEMP = 16.1

FRIDAY JUNE 22, 2018
 HOMESTAKE GEOCHEM BORINGS.
WME-7

0530 ARRIVE @ SITE

0555 SAFETY MEETING.

0600 PREPARE SAMPLES FOR
 SHIPPING.

0620 @ WME-4

DTW = 58.60 T.O.C.

TD = 67.63 T.O.C.

0640 COLLECT SAMPLE FOR
 WME-4 COLUMN.

PH = 10.06

EC = 26,220 μ S/cm

TEMP = 14.6°C

6 GALLONS PURGED.

PURGED DRY.

0700 WME-5

DTW = 71.65 T.O.C.

T.D. = 77.0 T.O.C.

0800 WME-4 COLUMN FILLED.

2.75 GALLONS.

3.50

FRIDAY JUNE 22, 2018
WME-7

75'-85': SAND. LOOSE.
 FINE-V. FINE.

TAILINGS → MASSIVE BEDDING.
 WET. MED. DARK
 GRAY. MOD. HCl REA.

85'-86': CLAY. DENSE. HARD.
 NATIVE → MOTTLED ROOT
 STRONG HCl → MATERIAL. LIGHT TO
 V. DARK BROWN. DRY.

86'-88': SAND. SOFT-LOOSE.
 VERY WELL SORTED.
 MOD HCl REA FINE SAND. DRY.
 → LIGHT-DARK GRAY.

88'-98': SAND. SOFT-LOOSE.
 VERY WELL SORTED.
 FINE. DRY. MOTTLED /
 BROWN STAINING.
 No-Weak
 HCl REA
 → LIGHT YELLOWISH BROWN
 w/ ORANGE-RED
 STAINING.

FRIDAY JUNE 22, 2018
WME-7

98'-99': SAND. LOOSE. VERY WELL
 SORTED. FINE. NO STAINING.
 STRONG HCl → MEDIUM BROWN. WET.

99'-105': SAND. SOFT-LOOSE.
 WELL SORTED. FINE.
 IRON STAINING AND
 MOTTLED. LIGHT BROWN
 STRONG HCl → w/ ORANGE STAINING.
 WET.

105'-109': SAND. LOOSE. VERY WELL
 SORTED. FINE. NO STAIN.
 MEDIUM BROWN. WET.

STRONG HCl REA → (SAMPLE @ 108')
 PERCHED ZONE

109'-113': CLAY. V. DENSE. SLIGHT
 MOISTURE. BROWNISH
 RED. STRONG HCl REA

110' (CONFINING LAYER)

113'-116': SAND. LOOSE. V. WELL SORTED.
 FINE. MED. BROWN. NO
 STAIN. DRY. STRONG HCl REA.

FRIDAY JUNE 22, 2018

WME-7 (LTP SAND BORING)WME-8 (LTP SLIME BORING)

116'-120': SAME AS ABOVE.

-WET

0845 GROUT WME-7

1010 MAST UP ON WME-8

1130 LUNCH BREAK @ 35'

1220 RELINQUISH SAMPLES

COLLECTED TO DATE TO

CHUCK FARR. - WILL SHIP.

1240 RESUME DRILLING WME-8

1440 @105' - COLLECT CORE FROM 85'

1530 @120' - COLLECT CORE FROM 105'

1420 @140' - COLLECT CORE FROM 120'

85'-87': TAILINGS: SANDY CLAY, MED

DENSE. 1/2 FINE SAND 20-30%.

MEDIUM GRAY. WET. MODERATE

RXN TO 10% HCl.

87'-90' TRANSITION ZONE. SAND w/

SOME TAILINGS CLAY. FINE SAND

LOOSE. MEDIUM BROWN w/ GRAY

CLAY STRINGERS. STRONG HCl RXN.

FRIDAY JUNE 22, 2018

WME-8

90'-92': NATIVE SAND. NO TAILINGS.

FINE-MED SAND. LOOSE.

WET. MED. BROWN.

STRONG HCl RXN.

92'-98': NATIVE CLAY. HARD. DENSE.

DRY. MOTTLED. GRAYS-BLACK.

STRONG HCl RXN.

98'-98': SAND. SOFT-LOOSE. VERY WELL

SORTED. FINE. DRY. LIGHT

TO DARK GRAY. MODERATE

HCl RXN.

98'-105' SAND. SOFT-LOOSE. VERY WELL

SORTED FINE SAND. MOTTLED.

IRON STAINING ORANGE →

RED. MODERATE BROWN.

NO RXN TO 10% HCl. DRY.

105'-110' SAME AS ABOVE. ~~VERY~~ STRONG HCl RXN.

COLLECT WME-8 @ 110'

111'-121' CLAY. STIFF/HARD. MOIST. HCl RXN.

121'-128' SAND. LOOSE. FINE. DRY.

COLLECT WME-8 @ 121'

123'-130' SAME AS ABOVE. WET.

SATURDAY JUNE 23, 2018
HOMESTAKE GEOCHEM BORINGS.

0530 ARRIVE @ SITE

0535 SAFETY MEETING.

- GROUT WME-B

- MOBILIZE TO DECON PAD

- GET SCANNED OUT.

- COLLECT SAMPLE @ #16

0555 PREPARE TO GROUT #8

@ WME-16

DTK = 55.7 T.O.C.

PURGED DRY @ 22-2018

@ 17:00

0610 COLLECT SAMPLE FOR

WME-16 COLUMN. (S)

0650 WME-16 FULL. 3.75 GALLONS

0730 MOBILIZE TO DECON PAD.

0800 @ DECON PAD.

1045 DEVELOPER RIG CLEARED
TO LEAVE.

1140 DRILL RIG & WATER TRUCK
CLEARED TO MOVE TO
ALLUVIAL BORINGS.

1200 TOWER UP ON WME-17
* IN ROAD SOUTH OF LTP.

SATURDAY JUNE 23, 2018

WME-17 (ALLUVIAL BORING)

1300 @ 25' GRAVELY SAND. DRY.
YELLOWISH BROWN.

1310 @ 35' SAND w/ TRACE CLAY.
MOIST REDDISH BROWN.

1330 @ 40' SAND. LOOSE. FINE.
DRY. VERY LIGHT BROWN.

1355 @ 55' SAND w/ ~~TRACE~~ CLAY.
STRONG RAIN LOOSE. WHOLE SORTED.
NO HCL → FINE. WET MOD.
REDDISH BROWN. → BROWN.

1400' COLLECT WME-17 @
55'.

NOTE: DENSE RED CLAY
LAYER @ 48'-52'.

1402 - MOBILIZE TO WME-16

1440 MAKE UP ON WME-16.

TARGET = 60'-65'

1500 TAKE 24-HOUR SAMPLE
ON WME-4.

pH = 9.97

* TAKE WME-16 24-HOUR
TOMORROW AM.

SATURDAY JUNE 23, 2018
WME-16

1515 @ 35': SAND, LOOSE. DRY.

LIGHT BROWN.

DENSE CLAY ABOVE. ~50'.

SLIGHT. MOIST.

1550 @ 55': SAND. LOOSE. FINE-MED.

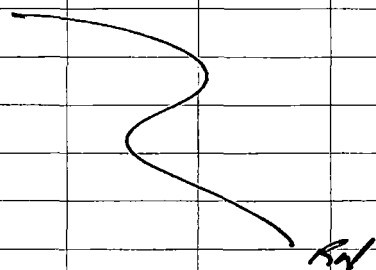
LIGHT BROWN WET.

1600 @ 5' SAME AS ABOVE.

COLLECT WME-16

@ 105'

1630 LEAVE SITE.



SUNDAY JUNE 24, 2018
 HOMESTAKE GEOCHEM ALLUVIAL
 BORINGS.

WME-14

0530 ARRIVE @ SITE.

0535 SAFETY & OPS MEETING.

Z-MAN CREW.

MOB TO 14 & 15.

0645 @ WME-14.

0700 COLLECT SAMPLE FROM
 COLLAR #2. (24-HOUR)

pH = 10.19

0730 @ 5' WME-14.

SAND. LOOSE. FINE. DRY.

& VERY LIGHT BROWN / CREAM.

0745 NO RETURNS 5'-15'.

0800 - DRY @ 25' SAND. LOOSE.

0805 - MOIST @ 35' CLAY @ ~50'

0818 - COLLECT WME-14 FROM

0820 45'. WET. SA

GRAVELY SAND w/ CLAY.

STRONG Rn TO HCl.

LIGHT BROWNISH GRAY.

SUNDAY JUNE 24, 2018
WME-15

0900 @ WME-15.

ESTIMATED DEPTH TO G.W.
 = 31'

ESTIMATE SAMPLE INT. = 40'-45'

0935 @ 18' SAND w/ TRACE GRAVEL.
 FINE - V. FINE SAND.

<10% GRAVEL. DRY.

0950 @ 28' SAND w/ TRACE CLAY.
 SLIGHTLY MOIST.

1000 @ 35' SAME AS ABOVE. DRY.

1035 @ 55' SAND w/ TRACE OF CLAY.
 REDDISH BROWN. FINE SAND
 WET. WATER @ 45'

1100 @ 60' CLAY. HARD. SLIGHTLY
 MOIST. BOTTOM OF SATURATION.
 COLLECT SAMPLE FROM 55'
 SAND w/ TRACE CLAY. LOOSE.
 POORLY SORTED FINE-COARSE.
 STIFF CLAY LENSES. <10%
 STRONG RUN TO NCL

1105 PREPARE TO GRANT HOLE.

1230 HOLE GRANTED AS PER
 DRILLING PLAN.

SUNDAY JUNE 24, 2018
WME-13

1230 PULL REMAINING CASING.

1240 PREPARE TO MOBILIZE
 TO WME-13.

1320 MASTER UP ON WME-13
 PROJECTED DTH = 69' BGS

PROJECTED SAMPLE DEPTH = 70'.

1415 @ 35' DRY LOOSE FINE SAND.

HOLE COLLAPSING. MIX GEL
 SLURRY TO IMPROVE BOREHOLE
 STABILITY.

NOTE: DRY, LOOSE, FINE DRY
 SAND IS WORST CONDITIONS
 FOR SONIC DRILLING.

1445 @ 47' SAND. LOOSE. DRY.

1500 @ 55' LOOSE DRY SAND.

1525 @ 57' VERY HARD DRILLING.

1545 VOLCANIC BEDROCK @
 57' BGS.

CAN DWID LEVY.

- DECIDE TO ABANDON HOLE
 AND MOVE TO #12.

- COLLECT SAMPLE OF BEDROCK
 FROM 57'.

MONDAY JUNE 25, 2018
HOMESTAKE GEOCHEM BORINGS.

WME-12

0530 ARRIVE @ SITE.

0535 SAFETY & OPS.

- TEMP WORKER FOR CASCADE
MUST BE ESCORTED AT ALL
TIMES.

- MDS TO WME-12.

- DECON AFTER #11.

0550 @ WME-13.

- PULL CASING & ABANDON HOLE.

0635 MOBILIZE TO WME-12

0650 TOWER UP ON WME-12.

& PREDICTED DTK = 65'

* SAMPLE @ 75'-85'

* SAT. THICKNESS = 35'

0845 BEDROCK @ 25'.

MOVE FURTHER EAST.

0930 RIG @ NEW WME-12.

1005 BEDROCK @ 20' EAS.

1010 CONSULT DAVE LEVY &

ADAM @ HOMESTAKE.

1030 ADAM @ SITE

MONDAY JUNE 25, 2018

WME-11

1035 : ADAM CONFIRMS THAT
ALLUVIAL AQUIFER IS BELOW
30'-50' OF LAVA FLOWS IN
WME-12 + WME-13 AREA.
SONIC CANNOT PENETRATE.
MOVE ON TO WME-11

1100 @ WME-11.

- TARGET 65'

1115 @ WME-5.

COLLECT SAMPLE FOR
COLUMN #5.

PH = 10.44

1200 COLUMN #5 FULL.

4.0 GALLONS OF WATER.

1215 WME-11

@ 55'. K/ET. SAND. LOOSE.

MED. BROWN.

1230 K/WME-11

@ 65'. SAND w/ GRAVEL. LOOSE.

POREY SORTED. FINE COARSE.

10% GRAVEL. BROWN HCL. RND.

MED. BROWN w/ BLACK.

WELL I.D.	D.T.W. (T.O.C)	T.D. (T.O.C)	SAT. THICK.	WELL VOLUME
WME-1	53.45	57.30	3.85	2.51
WME-2	57.25	64.60	7.35	4.8
WME-3	61.30	72.65	11.35	7.41
WME-4	57.49	67.60	10.11	6.60
WME-5	66.98	77.32	10.34	6.75
WME-6	54.95	67.25	12.30	8.0
WME-9	58.50	73.30	13.80	9.0
WME-10	58.80	76.30	17.80	11.6

* MEASURED JUNE 25, 2018

MONDAY JUNE 25, 2018
HOMESTAKE GEOCHEM WELLS & BURNES.

1200 FINAL CHECK LIST:

- ✓ EXIT BIO ASSAY
- ✓ BADGE BOOK RETURNED. & BADGE.
- ✓ COLUMN #5 FILLED.
- ✓ ALL COLUMNS FILLED & SECURE.
- ✓ WATER LEVEL METER RETURNED.
- ✓ SCALE RETURNED.
- ✓ COC COMPLETE.
- ✓ SAMPLES READY FOR SHIPPING.
- ✓ BARBRA GALLEGO'S WILL SAMPLE #5 6/26/2018.
- ✓ BADGE RETURNED
- ✓ FINAL WATER LEVELS + TD'S.
- ✓ T & B CUTTINGS WILL BE PICKED UP BY BILLY.
- ✓ NITROGEN RETURNED ^{*KEEP} REGULATOR!
- ✓ #4 & #6 SAMPLES GIVEN TO BARBRA.

- EMAIL CHUCK FARR = SAMPLE PICK UP.

Appendix C

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Photos

- Photo 1. LTP Tailing Sands from WME-1
- Photo 2. LTP Tailings Sands from WME-2
- Photo 3. LTP Tailings Slimes from WME-4
- Photo 4. Filling Column 4 at WME-4
- Photo 5. LTP Tailings Slimes from WME-5
- Photo 6. STP Tailings Sands from WME-9
- Photo 7. STP Tailings Slimes from WME-10
- Photo 8. Alluvial Material Below LTP from Alluvial Boring WME-7
- Photo 9. Perched Alluvium Below LTP from Alluvial Boring WME-7
- Photo 10. Vadose Alluvium Below LTP from Alluvial Boring WME-7
- Photo 11. Perched Alluvium Below LTP from Alluvial Boring WME-8
- Photo 12. Vadose Alluvium Below LTP from Alluvial Boring WME-8
- Photo 13. Alluvial Boring WME-11 @ 65'
- Photo 14. Bedrock Encountered in WME-13 @ 20'
- Photo 15. Alluvial Boring WME-14 @ 45'
- Photo 16. Alluvial Boring WME-15 @ 55'
- Photo 17. Alluvial Boring WME-16 @ 65'
- Photo 18. Alluvial Boring WME-17 @ 55'

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Photo 1. LTP Tailings Sands from WME-1

PICTURE DESCRIPTORS:

Location (ID or description):
WME-1 on LTP

Date:
June 14, 2018

Details or Comments:

Tailings Sands from WME-1. Dry tailings are on the bottom with wet tailings on top.

45'-55'

Sand with Some Clay. 10%-20%. Loose. Well Sorted. Fine Sand. Stiff Clay. Weak Reaction to 10% HCl. Moist to Wet. Medium to Dark Gray.



Photo 2. LTP Tailings Sands from WME-2

PICTURE DESCRIPTORS:

Location (ID or description):
WME-2 on LTP

Date:
June 15, 2018

Details or Comments:

Tailings Sands from WME-2.

45'-55'

Sand with Some Clay. <20%. Loose. Well Sorted. Fine Sand. Some Clay Stringers. Weak to No Reaction to 10% HCL. Moist to Wet. Medium Gray.

**PICTURE DESCRIPTORS:**

Location (ID or description):
WME-4 on LTP

Date:
June 17, 2018

Details or Comments:
Tailings Slimes from WME-4.
45'-55'
Clay. Medium Stiff to Stiff. Thin
Laminations. No Sand. Moist to
Wet. Medium to Dark Gray..
Strong Reaction to 10% HCl.
Sulfur Smell.

Photo 3. LTP Tailings Slimes from WME-4

**PICTURE DESCRIPTORS:**

Location (ID or description):
WME-4 on LTP

Date:
June 17, 2017

Details or Comments:
Filling Column 4 with undisturbed
8-inch diameter core of Tailings
Slimes from WME-4.

Photo 4. Filling Column 4 with LTP Tailings Slimes



Photo 5. LTP Tailings Slimes from WME-5

PICTURE DESCRIPTORS:

Location (ID or description):
WME-5 on LTP

Date:
June 18, 2018

Details or Comments:
Tailings Slimes from WME-5
65'-75'
Clay with Trace Sand. <10%.
Medium Stiff to Soft. Wet. Medium
Dark Gray. Mild Reaction to 10%
HCl.



Photo 6. STP Tailings Sands from WME-9

PICTURE DESCRIPTORS:

Location (ID or description):
WME-9 on STP

Date:
June 20, 2018

Details or Comments:
Tailings Sands from WME-9 on
STP.
30'
Silty Sand with Trace of Clay.
Loose. Very Fine to Fine Sand.
30% Silt. 10% Clay. Light Brown.
Strong Reaction to 10% HCl.

**PICTURE DESCRIPTORS:**

Location (ID or description):
WME-10 on STP

Date:

June 20, 2018

Details or Comments:

Tailings Slimes from WME-10
35'
Sandy Clay. Hard. Dense. Stiff.
Slight Moisture. 30% Very Fine
Sand. Very Thin Bedding. Grays.
Light Brown. Black. Strong
Reaction to 10% HCl.

Photo 7. STP Tailings Slimes from WME-10

**PICTURE DESCRIPTORS:**

Location (ID or description):
[Click here to add location]

Date:

June 22, 2018

Details or Comments:

Left to Right. Top to Bottom.
75'-85': Tailings Sands
85'-86': Clay. Dense. Mottled. Roots.
86'-88': Native Sand. Loose. Dry.
88'-98': Sand. Mottled. Stain. Dry.
98'-109': "Perched Alluvium" Sand.
Stain. Wet.
109'-113': Clay. Stiff.
113'-116': "Vadose Alluvium" Sand.
Loose. Fine. Dry.
116'-120': Sand. Loose. Fine. Wet.

Photo 8. Boring WME-7 Alluvial Material Below LTP



Photo 9. Perched Alluvium Below LTP from WME-7

PICTURE DESCRIPTORS:

Location (ID or description):
Alluvial Boring WME-7 on LTP

Date:
June 22, 2018

Details or Comments:
98'-105'
Perched Alluvium
Fine Sand. Loose. Very Well
Sorted. Iron Staining and
Mottling. Light Brown with
Orange Stain. Wet. Strong
Reaction to 10% HCl.



Photo 10. Vadose Alluvium Below LTP from WME-7

PICTURE DESCRIPTORS:

Location (ID or description):
Alluvial Boring WME-7 on LTP

Date:
June 22, 2018

Details or Comments:
109'-113'
Confining Layer.
Clay. Very Stiff. Slight Moisture.
Brownish Red. Strong Reaction to
10% HCl.

113'-114'
Vadose Alluvium.
Sand. Loose. Very Well Sorted.
Fine Sand. Medium Brown. No
Stain. Dry. Strong Reaction to
10% HCl.



Photo 11. Perched Alluvium Below LTP from WME-8

PICTURE DESCRIPTORS:

Location (ID or description):
Alluvial Boring WME-8 on LTP

Date:
June 23, 2018

Details or Comments:
105'-111'
Perched Alluvium
Find Sand. Loose. Very Well
Sorted. Mottled and Iron Staining.
Orange to Red. Medium Brown.
Wet. Strong Reaction to 10% HCl.



Photo 12. Vadose Alluvium Below LTP from WME-8

PICTURE DESCRIPTORS:

Location (ID or description):
Alluvial Boring WME-8 on LTP

Date:
June 23, 2018

Details or Comments:
111'-121'
Confining Layer.
Clay. Very Stiff. Slight Moisture.
Medium Brown. Strong Reaction
to 10% HCl.

121'-123'
Vadose Alluvium.
Sand. Loose. Very Well Sorted.
Fine Sand. Medium Brown. No
Stain. Dry. Strong Reaction to
10% HCl.

**PICTURE DESCRIPTORS:**

Location (ID or description):
Alluvial Boring WME-13 @ 65'

Date:
June 25, 2018

Details or Comments:
WME-11 @ 65'
Sand with Some Gravel. Loose.
Poorly Sorted. Fine to Very
Coarse. 10% Gravel. Medium
Brown with Black. Strong
Reaction to 10% HCL.

Photo 13. Alluvial Boring WME-11 @ 65'

**PICTURE DESCRIPTORS:**

Location (ID or description):
Boring WME-13

Date:
June 25, 2018

Details or Comments:
Igneous Bedrock Encountered at
20' in WME-13.
No Alluvial Sample was collected
in WME-12 or WME-13 due to
drilling refusal before
groundwater was encountered.

Photo 14. Bedrock Encountered @ 20' in WME-13

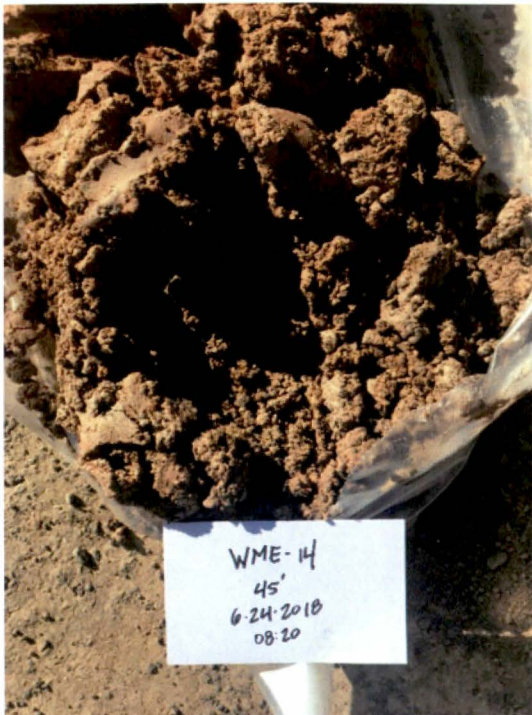


Photo 15. Alluvial Boring WME-14 @ 45'

PICTURE DESCRIPTORS:

Location (ID or description):
Alluvial Boring WME-14 @ 45'

Date:
June 24, 2018

Details or Comments:
WME-14 @ 45'
Gravelly Sand with Some Clay.
Loose. Poorly Sorted. Fine to Very
Coarse. 20% Gravel. <10% Clay.
Light Brownish Gray. Strong
Reaction to 10% HCl.



Photo 16. Alluvial Boring WME-15 @ 55'

PICTURE DESCRIPTORS:

Location (ID or description):
Alluvial Boring WME-15 @ 55'

Date:
June 24, 2018

Details or Comments:
WME-15 @ 55"
Sand with Trace of Clay. Loose.
Very Well Sorted. Fine. Wet.
Strong Reaction to 10% HCl.



Photo 17. Alluvial Boring WME-16 @ 65'

PICTURE DESCRIPTORS:

Location (ID or description):
Alluvial Boring WME-16 @ 65'

Date:
June 23, 2018

Details or Comments:
WME-16 @ 65'
Sand. Loose. Fine to Medium. No
Clay. Light Brown. Wet. Strong
Reaction to 10% HCl.



Photo 18. Alluvial Boring WME-17 @ 55'

PICTURE DESCRIPTORS:

Location (ID or description):
Alluvial Boring WME-17 @ 55'

Date:
June 23, 2018

Details or Comments:
WME-17 @ 55'
Fine Sand with Trace of Clay.
Loose. Very Well Sorted. Wet.
Reddish Brown to Brown. Strong
Reaction to 10% HCl.

Attachment 2

Tailings and Alluvial Water Quality Data

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Attachment 3

DCM Science XRD and SEM Mineralogy Reports

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12421 W. 49th Avenue, Unit #6
Wheat Ridge, CO 80033 (303) 463-8270

Semi-Quantitative X-Ray Diffraction Analysis

Page 1 of 5

Client:
ACZ Laboratories, Inc.
2773 Downhill Drive
Steamboat Springs, CO 80487

Analysis Date: 8-30-18
Reporting Date: 9-6-18
Receipt Date: 7-24-18
Client Job No.: None Given
Project Title: None Given
DCMSL Project: ACZ60

Client Sample No.:	WME-1	WME-2	WME-3	WME-4
--------------------	-------	-------	-------	-------

Bulk Sample

Quartz	47	55	59	46
K-Feldspar	15	14	11	13
Plagioclase	15	14	12	14
Calcite	10	8	8	8
Pyrite	1	1	1	1
Total Clay	12	8	9	18
Smectite	5	3	2	6
Illite	<1	<1	1	1
Kaolinite	6	4	4	9
Chlorite	1	1	1	2

Client Sample No.:	WME-5	WME-6	WME-9	WME-10
--------------------	-------	-------	-------	--------

Bulk Sample

Quartz	45	37	69	53
K-Feldspar	12	9	11	14
Plagioclase	12	12	10	14
Calcite	8	13	2	9
Pyrite	1	-	-	-
Total Clay	23	29	8	10
Smectite	9	13	3	4
Illite	2	2	2	1
Kaolinite	10	11	3	3
Chlorite	2	3	<1	2



12421 W. 49th Avenue, Unit #6
Wheat Ridge, CO 80033 (303) 463-8270

Semi-Quantitative X-Ray Diffraction Analysis

Page 2 of 5

Client:
ACZ Laboratories, Inc.
2773 Downhill Drive
Steamboat Springs, CO 80487

Analysis Date: 8-30-18
Reporting Date: 9-6-18
Receipt Date: 7-24-18
Client Job No.: None Given
Project Title: None Given
DCMSL Project: ACZ60

Client Sample No.:	WME-8@110	WME-8@121	WME-11	WME-14
--------------------	-----------	-----------	--------	--------

Bulk Sample

Quartz	72	74	73	40
K-Feldspar	10	8	7	5
Plagioclase	7	7	7	6
Calcite	4	6	9	21
Pyrite	-	-	1	-
Amorphous	-	-	-	13
Total Clay	7	5	3	15
Smectite	4	3	1	4
Illite	1	1	1	6
Kaolinite	2	1	1	5
Chlorite	<1	<1	-	-



12421 W. 49th Avenue, Unit #6
Wheat Ridge, CO 80033 (303) 463-8270

Semi-Quantitative X-Ray Diffraction Analysis

Page 3 of 5

Client:

ACZ Laboratories, Inc.
2773 Downhill Drive
Steamboat Springs, CO 80487

Analysis Date: 8-30-18
Reporting Date: 9-6-18
Receipt Date: 7-24-18
Client Job No.: None Given
Project Title: None Given
DCMSL Project: ACZ60

Client Sample No.:	WME-15	WME-16	WME-17
--------------------	--------	--------	--------

Bulk Sample

Quartz	72	77	77
K-Feldspar	7	8	8
Plagioclase	5	7	9
Calcite	11	6	4
Pyrite	-	-	-
Amorphous	-	-	-
Total Clay	5	2	2
Smectite	3	1	1
Illite	1	<1	<1
Kaolinite	1	1	1
Chlorite	-	<1	<1

The bulk samples were prepared for x-ray diffraction analysis and scanned over a range of 3° to 45° 2θ Cu Kα radiation, 40kV, 25mA. Mineral phases were identified with the aid of computer-assisted programs accessing a powder diffraction database. Estimates of mineral concentrations are based on relative peak heights and reference intensity ratios (RIR) measured in-house.



12421 W. 49th Avenue, Unit #6
Wheat Ridge, CO 80033 (303) 463-8270

Semi-Quantitative X-Ray Diffraction Analysis

Page 4 of 5

Client:

ACZ Laboratories, Inc.
2773 Downhill Drive
Steamboat Springs, CO 80487

Analysis Date: 8-30-18
Reporting Date: 9-6-18
Receipt Date: 7-24-18
Client Job No.: None Given
Project Title: None Given
DCMSL Project: ACZ60

Client Sample No.:	WME-1	WME-2	WME-3	WME-4
--------------------	-------	-------	-------	-------

Clay Fraction <2 μ m

Smectite	39	34	27	35
Illite	5	4	11	5
Kaolinite	49	56	48	49
Chlorite	7	6	14	11

Client Sample No.:	WME-5	WME-6	WME-9	WME-10
--------------------	-------	-------	-------	--------

Clay Fraction <2 μ m

Smectite	37	45	32	40
Illite	8	7	19	12
Kaolinite	44	39	42	33
Chlorite	11	9	7	15

Client Sample No.:	WME-8@110	WME-8@121	WME-11	WME-14
--------------------	-----------	-----------	--------	--------

Clay Fraction <2 μ m

Smectite	55	56	47	25
Illite	13	14	20	41
Kaolinite	29	27	33	34
Chlorite	3	3	-	-



12421 W. 49th Avenue, Unit #6
Wheat Ridge, CO 80033 (303) 463-8270

Semi-Quantitative X-Ray Diffraction Analysis

Page 5 of 5

Client:

ACZ Laboratories, Inc.
2773 Downhill Drive
Steamboat Springs, CO 80487

Analysis Date: 8-30-18
Reporting Date: 9-6-18
Receipt Date: 7-24-18
Client Job No.: None Given
Project Title: None Given
DCMSL Project: ACZ60

Client Sample No.:	WME-15	WME-16	WME-17
--------------------	--------	--------	--------

Clay Fraction <2 μ m

Smectite	64	44	32
Illite	15	18	18
Kaolinite	21	36	47
Chlorite	-	2	3

An oriented clay mount (<2 μ m) was prepared for x-ray diffraction analysis and scanned over a range of 3° to 40° 2 θ Cu Ka radiation, 40kV, 25mA. The mount was analyzed air-dried (RH ~25%) and glycolated. Clay concentrations are based on peak areas and intensity factors measured in-house on known standards or computer calculated.

Ron Schott, Analyst



Laboratories, Inc.

2773 Downhill Drive Steamboat Springs, CO 80487 (800) 334-5493

CHAIN of CUSTODY

Report to:

Name: Scott Habermehl

Company: ACZ Labs

E-mail: scotth@acz.com

Address: 2773 Downhill Dr.

Telephone: (970)879-6590 x101

Copy of Report to:

Name:

Company:

E-mail:

Telephone:

Invoice to:

Name: Jason Calo

Company: ACZ Labs

E-mail: jcalo@acz.com

Address:

Telephone:

If sample(s) received past holding time (HT), or if insufficient HT remains to complete analysis before expiration, shall ACZ proceed with requested short HT analyses?

YES

NO

☒
☐

If "NO" then ACZ will contact client for further instruction. If neither "YES" nor "NO" is indicated, ACZ will proceed with the requested analyses, even if HT is expired, and data will be qualified.

Are samples for SDWA Compliance Monitoring?

Yes

☐

No

☒

If yes, please include state forms. Results will be reported to PQL for Colorado.

Sampler's Name: _____ Sampler's Site Information State CO Zip code _____ Time Zone _____

*Sampler's Signature: _____

*I attest to the authenticity and validity of this sample. I understand that intentionally mislabeling the time/date/location or tampering with the sample in anyway, is considered fraud and punishable by State Law.

PROJECT INFORMATION

ANALYSES REQUESTED (attach list or use quote number)

Quote #:

PO#:

Reporting state for compliance testing

Check box if samples include NRC licensed material? ☐

SAMPLE IDENTIFICATION	DATE:TIME	Matrix	# of Containers	ANALYSES REQUESTED (attach list or use quote number)									
				XPD - Bulk & Clay	SETA								
9 WME-8@110/c	6/14/18	SO	1	☒	☐	☐	☐	☐	☐	☐	☐	☐	☐
10 WME-8@121/c	6/18/18	SO	1	☒	☐	☐	☐	☐	☐	☐	☐	☐	☐
11 WME-11/c	6/15/18	SO	1	☒	☐	☐	☐	☐	☐	☐	☐	☐	☐
12 WME-14/c	6/17/18	SO	1	☒	☒	☐	☐	☐	☐	☐	☐	☐	☐
13 WME-15/c	6/18/18	SO	1	☒	☐	☐	☐	☐	☐	☐	☐	☐	☐
14 WME-16/c	6/19/18	SO	1	☒	☒	☐	☐	☐	☐	☐	☐	☐	☐
15 WME-17	6/19/19	SO	1	☒	☐	☐	☐	☐	☐	☐	☐	☐	☐
				☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
				☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
				☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

Matrix: SW (Surface Water) GW (Ground Water) WW (Waste Water) DW (Drinking Water) SL (Sludge) SO (Soil) OL (Oil) Other (Specify):

REMARKS

DCM Science, 12421 W. 49th St. Unit 6, Wheat Ridge CO 80033

Please refer to ACZ's terms & conditions located on the reverse side of this COC.

RELINQUISHED BY:	DATE:TIME	RECEIVED BY:	DATE:TIME
		<i>D. Habermehl</i>	7/24/18 10:30



September 6, 2018

Mr. Scott Habermehl
ACZ Laboratories, Inc.
2773 Downhill Drive
Steamboat Springs, CO 80487

Dear Mr. Habermehl:

We have performed scanning electron microscopy analysis on your six soil/tailing samples (client sample number **WME-2, WME-3, WME-5, WME-10, WME-14** and **WME-16**). The results are outlined in the following report.

Thank you for the opportunity to provide this service. If you have any questions, please call.

Sincerely,

A handwritten signature in black ink that reads "Ron Schott". The signature is written in a cursive, flowing style.

Ron Schott
Analyst

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12421 W. 49th Avenue, Unit #6
Wheat Ridge, CO 80033 - (303) 463-8270

Scanning Electron Microscopy Analysis

Page 1 of 56

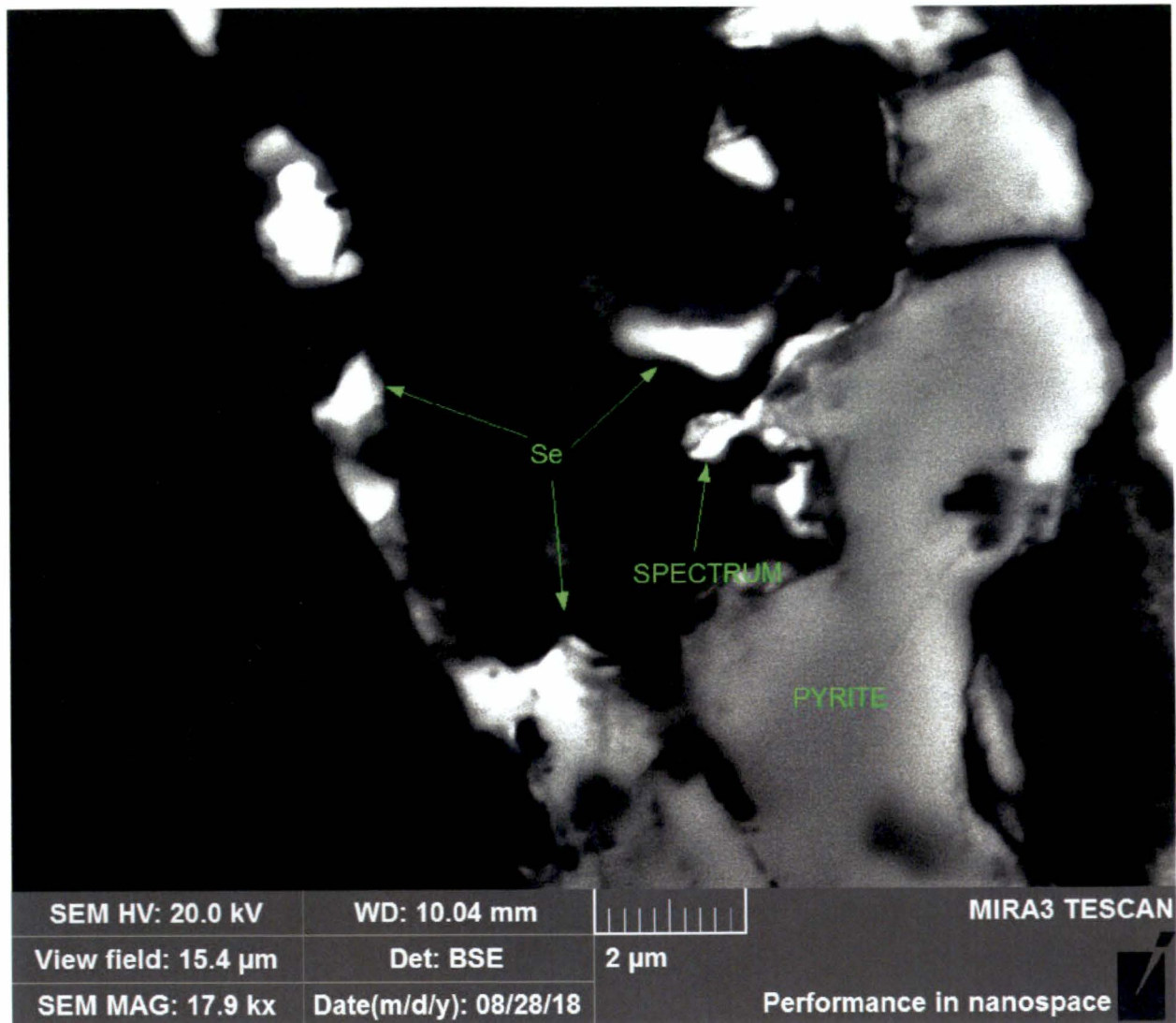
Client:	Analysis Date:	9-5-18
ACZ Laboratories Inc.	Reporting Date:	9-6-18
2773 Downhill Dr.	Receipt Date:	7-24-18
Steamboat Springs, CO 80487	Client Job No.:	None Given
	Project Title:	None Given
	DCMSL Project:	ACZ61

The objective of this project is to determine U associations with other mineral phases contained in six soil/tailing samples (client samples no. **WME-2, WME-3, WME-5, WME-10, WME-14** and **WME-16**). Each sample was prepared as a polished thin section for study by field emission scanning electron microscopy (FE-SEM) equipped with an energy dispersive system (EDS). Particles of interest were identified using backscatter imaging at magnifications ranging from 500X to 50,000X, 20keV. FE-SEM images, spectra and some quant tables of relevant features are included for documentation.

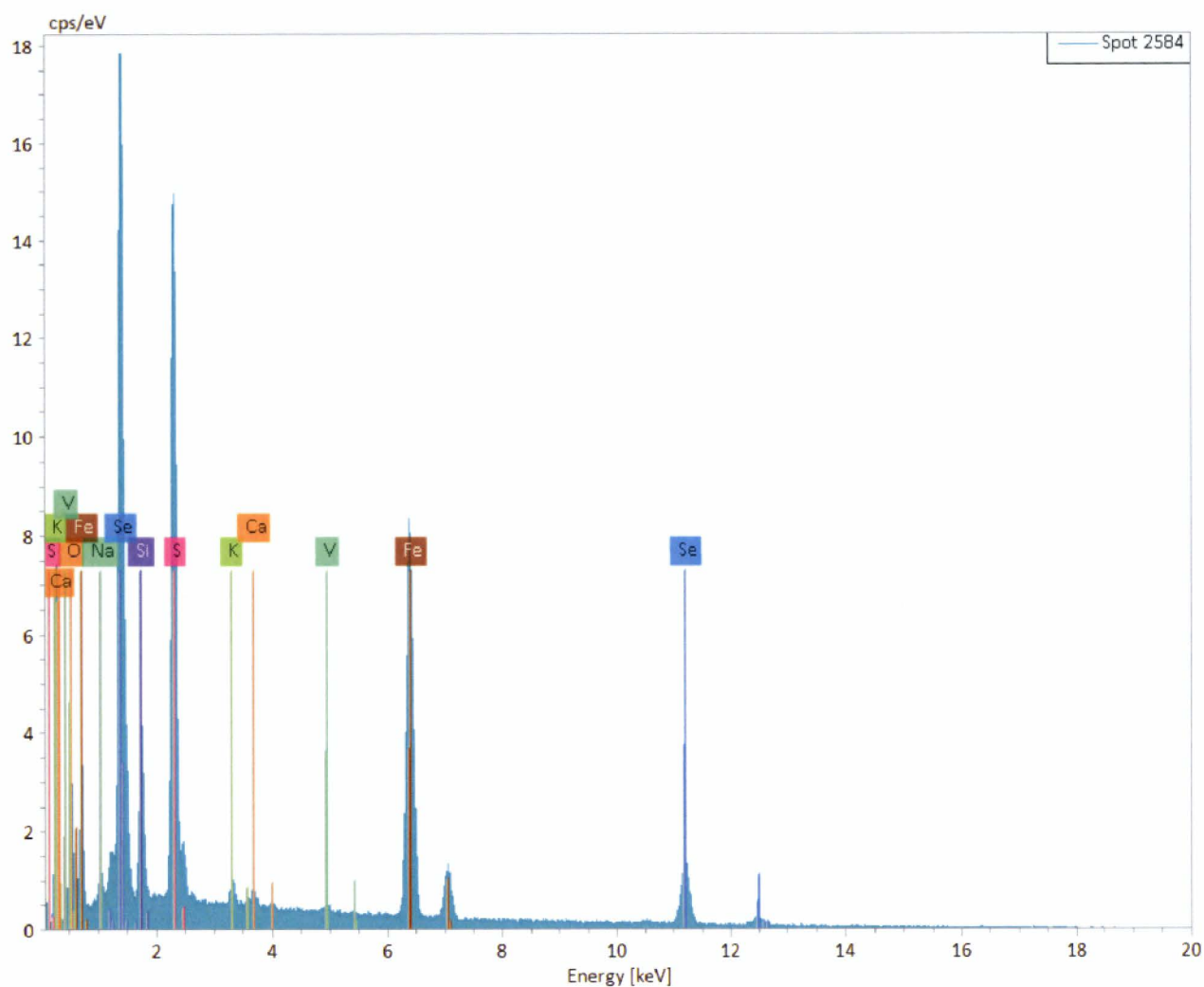
Client Sample No.: **WME-2**

This sample is a brown colored very fine to medium grained, silty sand with some clay content. Quartz (~55%) is the primary hard silicate and occurs as angular to rounded grains that vary greatly in size from 10 μ m up to 500 μ m. Plagioclase and potassium feldspar are present in like amounts. Plagioclase (~14%) occurs as angular fragments in the 5 μ m to 200 μ m size range. The plagioclase is commonly pitted and has corroded grain boundaries. K-spar (~14%) is angular to sub-rounded with a similar size range as the plagioclase. The feldspars commonly carry minute grains of zircon, xenotime and other rare earth phosphates of the monazite mineral group. Calcite (~8%) occurs as liberated grains in a size range of 10 μ m up to 250 μ m. A few fine-grained aggregates are also present. Clay is present in low amounts (~8%) and is seen coating quartz/feldspar and as small masses. XRD identifies the clay as mainly kaolinite (~4%), swelling smectite (~3%) and low amounts of illite (<1%) and chlorite (~1%). EDS x-ray microanalysis of several clay masses failed to detect U. Sulfides are present with pyrite as the primary type (~1%). Pyrite occurs as liberated fragments and as small inclusions in quartz. One fairly large pyrite mass is seen wearing a thin rind of Se with detectable V. Native Se and FeSe (ferroselite?) are also seen as minute liberated fragments. Although chalcopyrite is rare, it is present as minute inclusions in quartz/feldspar and pyrite. Barite is the only sulfate identified

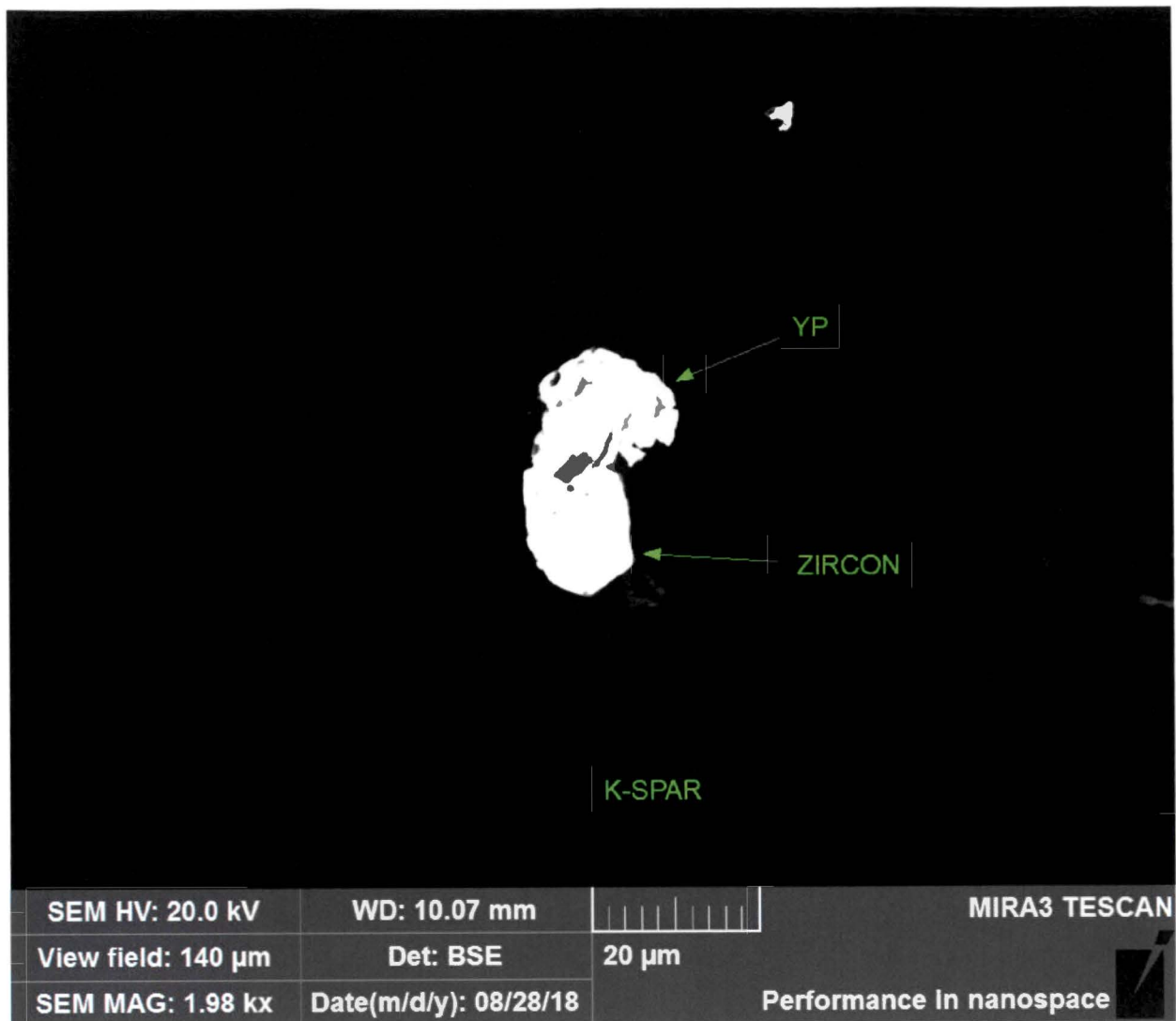
and occurs as liberated fragments and minute inclusions in quartz/feldspar. Oxides are present as a trace and include hematite, rutile, magnetite and Cu oxide with some Zn content. Two small grains of a U phase were identified attached to K-spar. The largest grain measures $\sim 10\mu\text{m}$ and is composed primarily of U with lesser amounts of Ca and V.



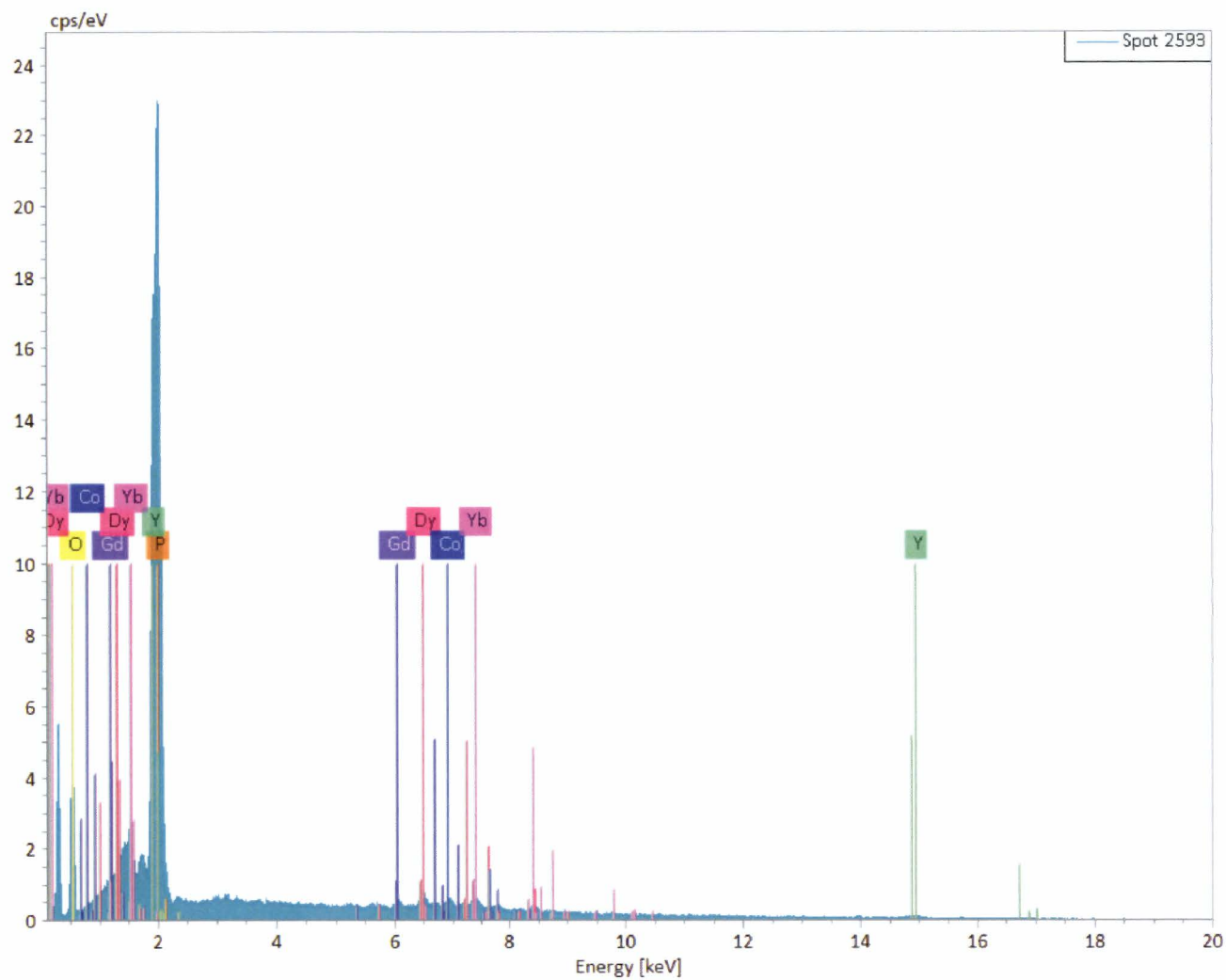
Client Sample No.: **WME-2**
Backscatter image of pyrite rimmed with Se – 17,900X

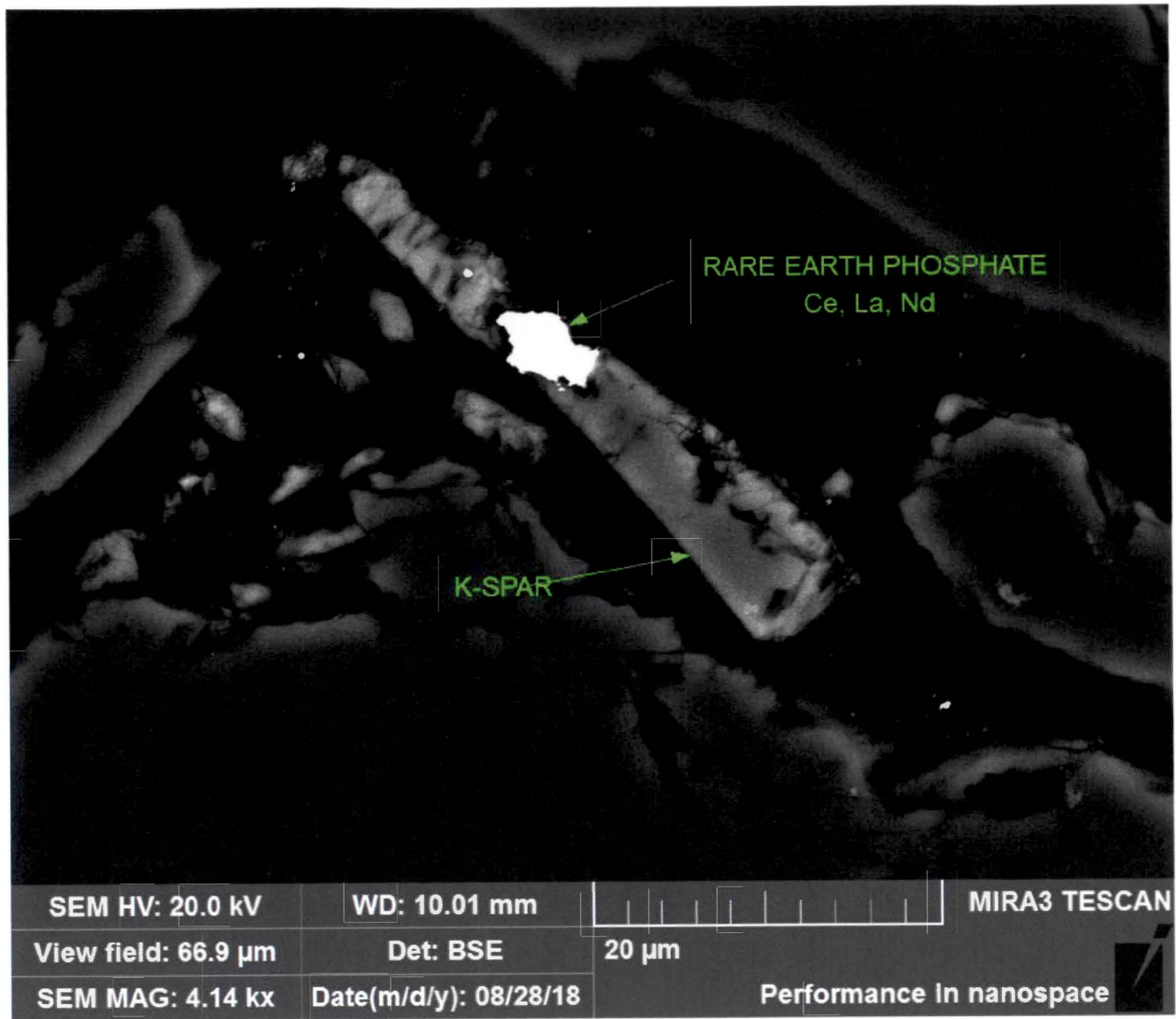


Element	At. No.	Netto	Mass [%]	Mass Norm. [%]	Atom [%]	abs. error [%] (1 sigma)	rel. error [%] (1 sigma)
Oxygen	8	667	0.49	0.85	3.36	0.15	30.54
Silicon	14	170	0.04	0.07	0.17	0.00	10.17
Sulfur	16	5061	1.10	1.90	3.74	0.07	6.28
Iron	26	58263	26.33	45.27	51.21	0.73	2.78
Selenium	34	25658	30.19	51.91	41.53	0.94	3.10
		Sum	58.16	100.00	100.00		

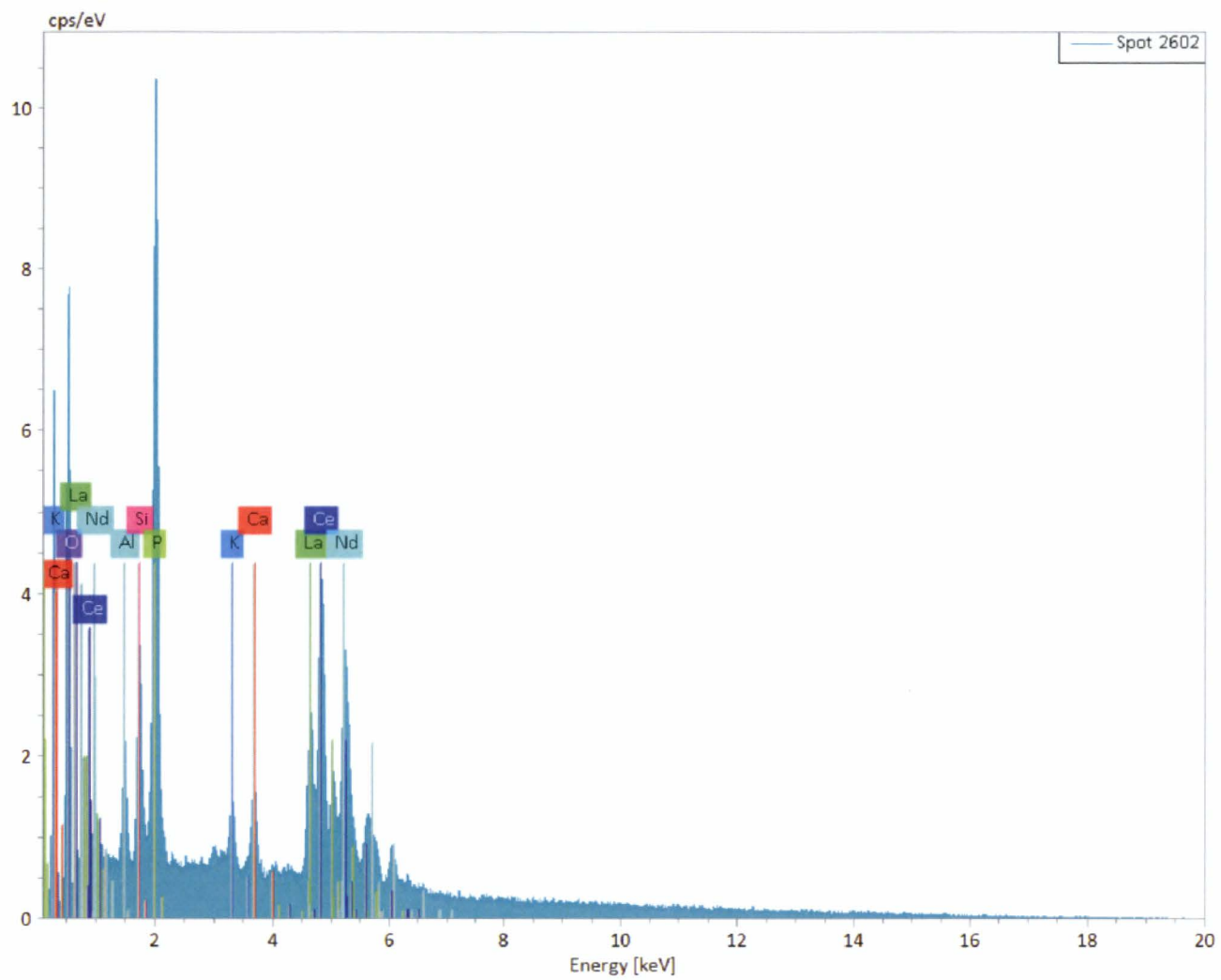


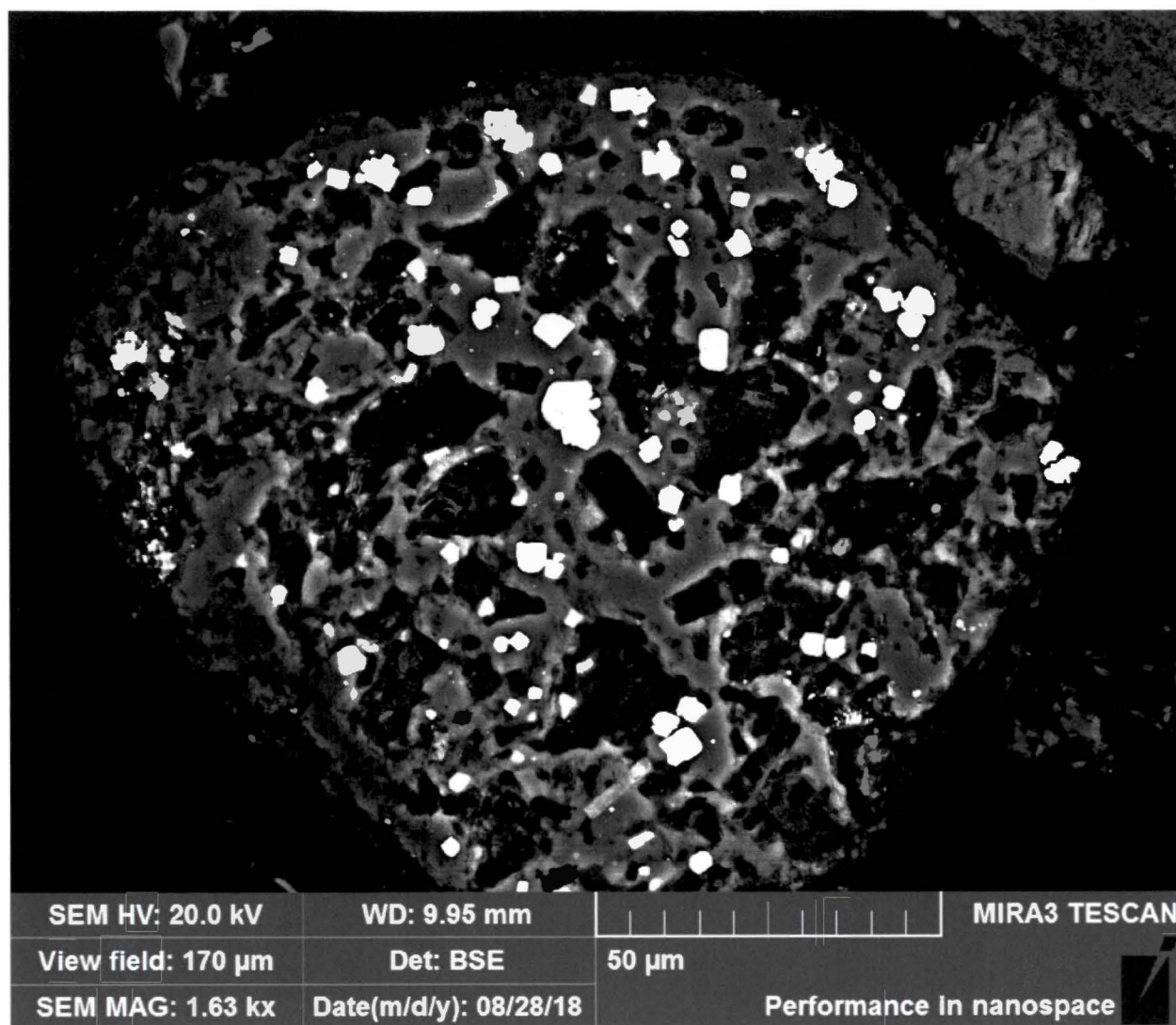
Client Sample No.: **WME-2**
Backscatter image of zircon and xenotime included in K-spar – 1,980X





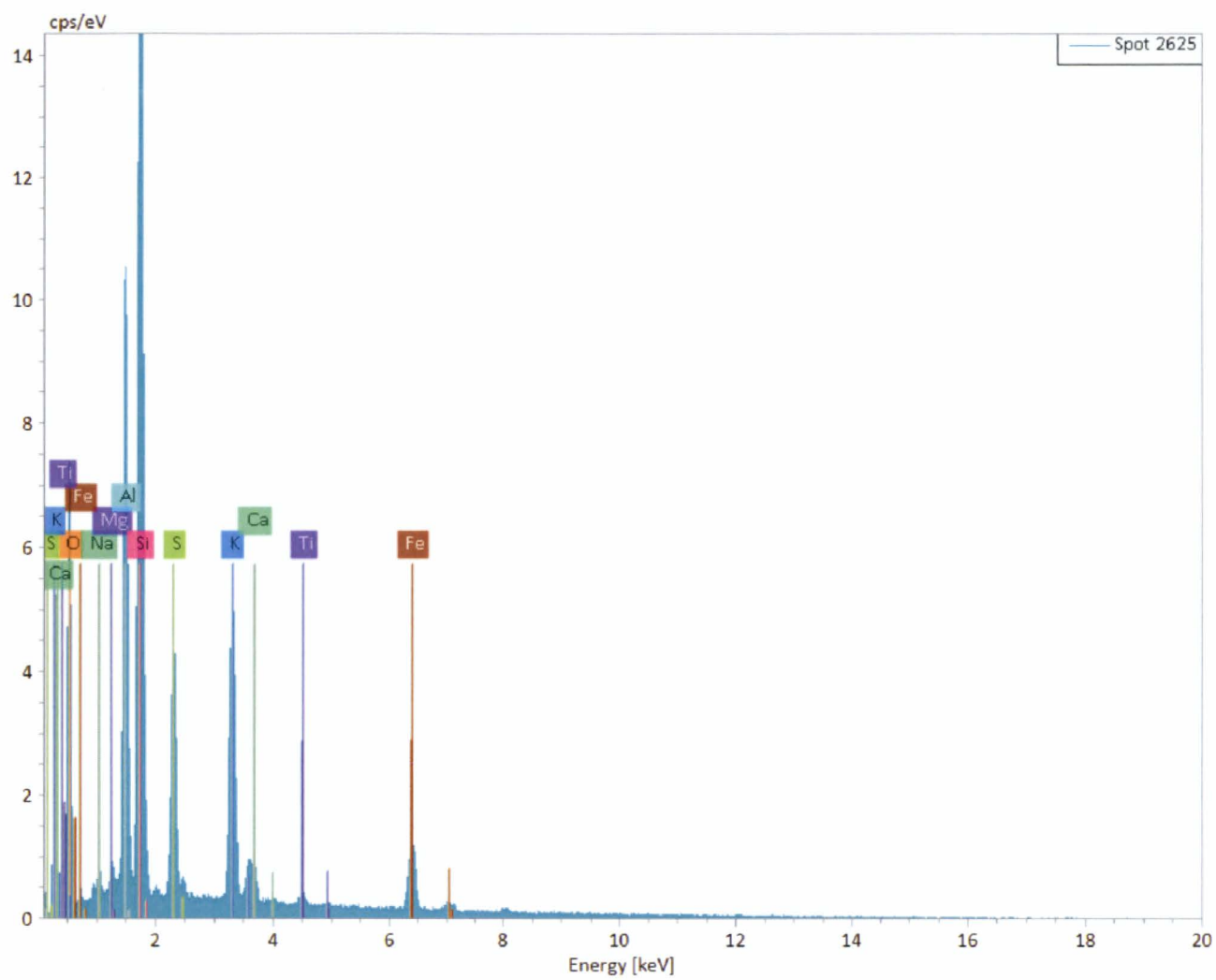
Client Sample No.: **WME-2**
Backscatter image of a monazite grain included in K-spar – 4,150X

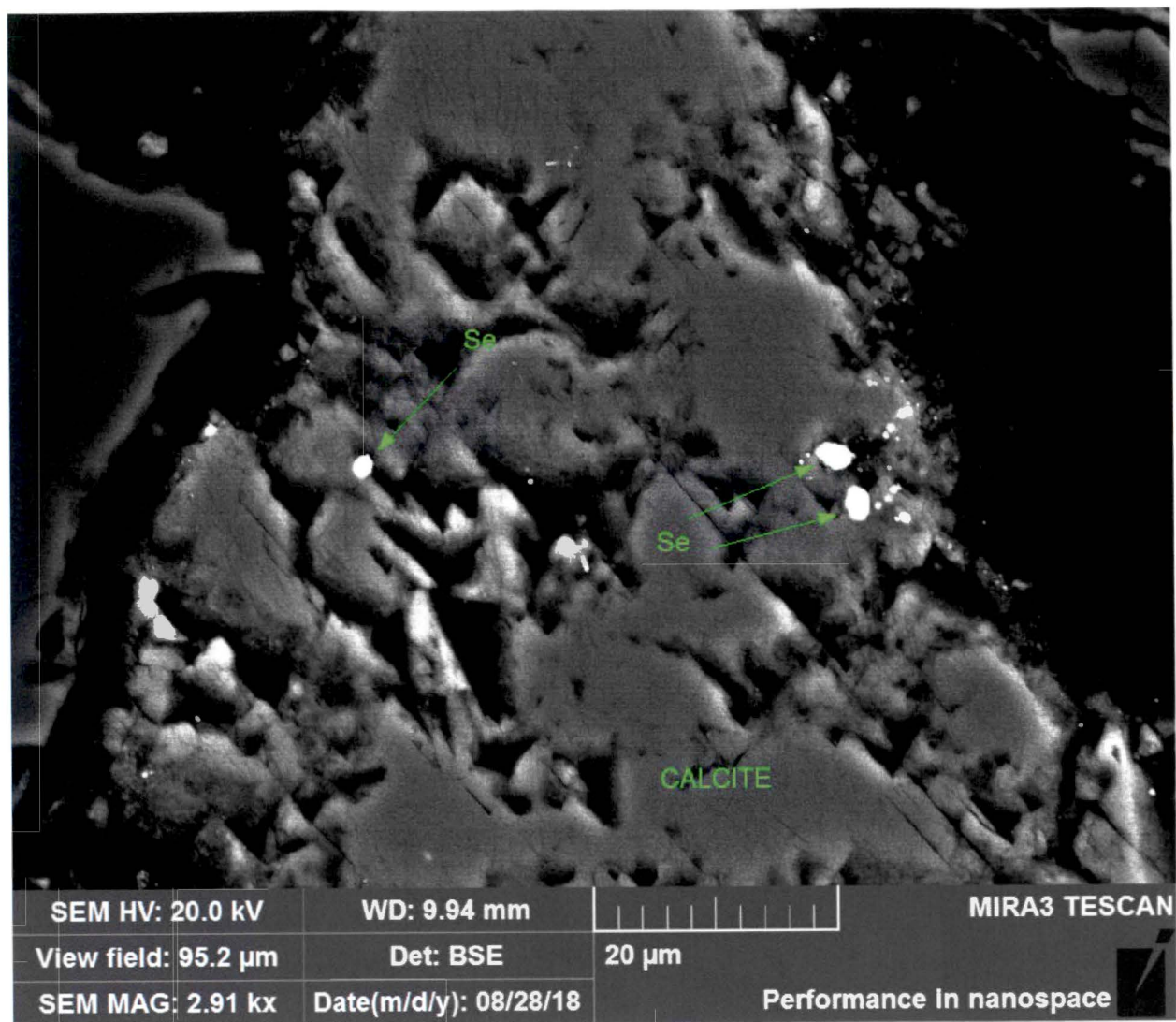




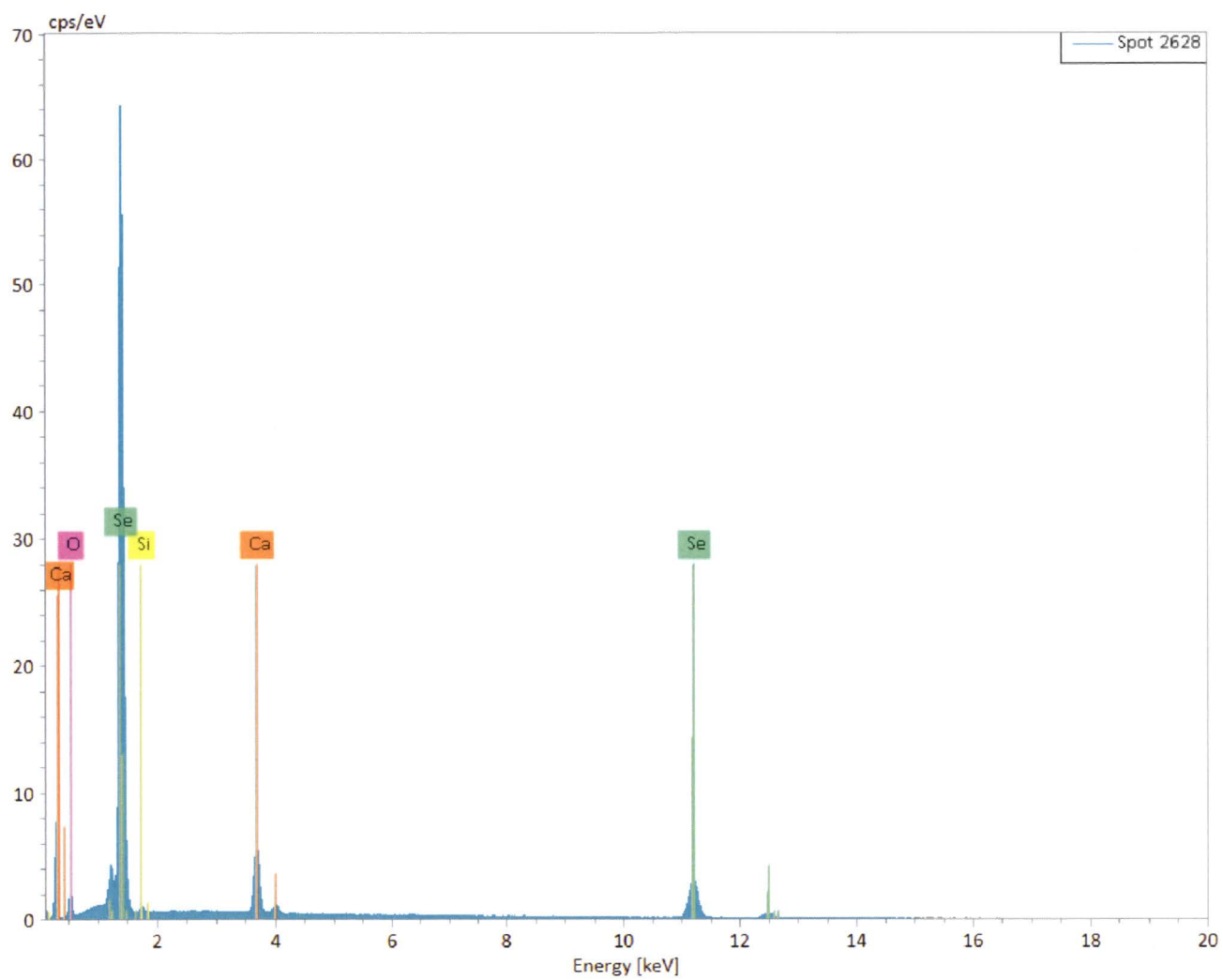
Client Sample No.: **WME-2**

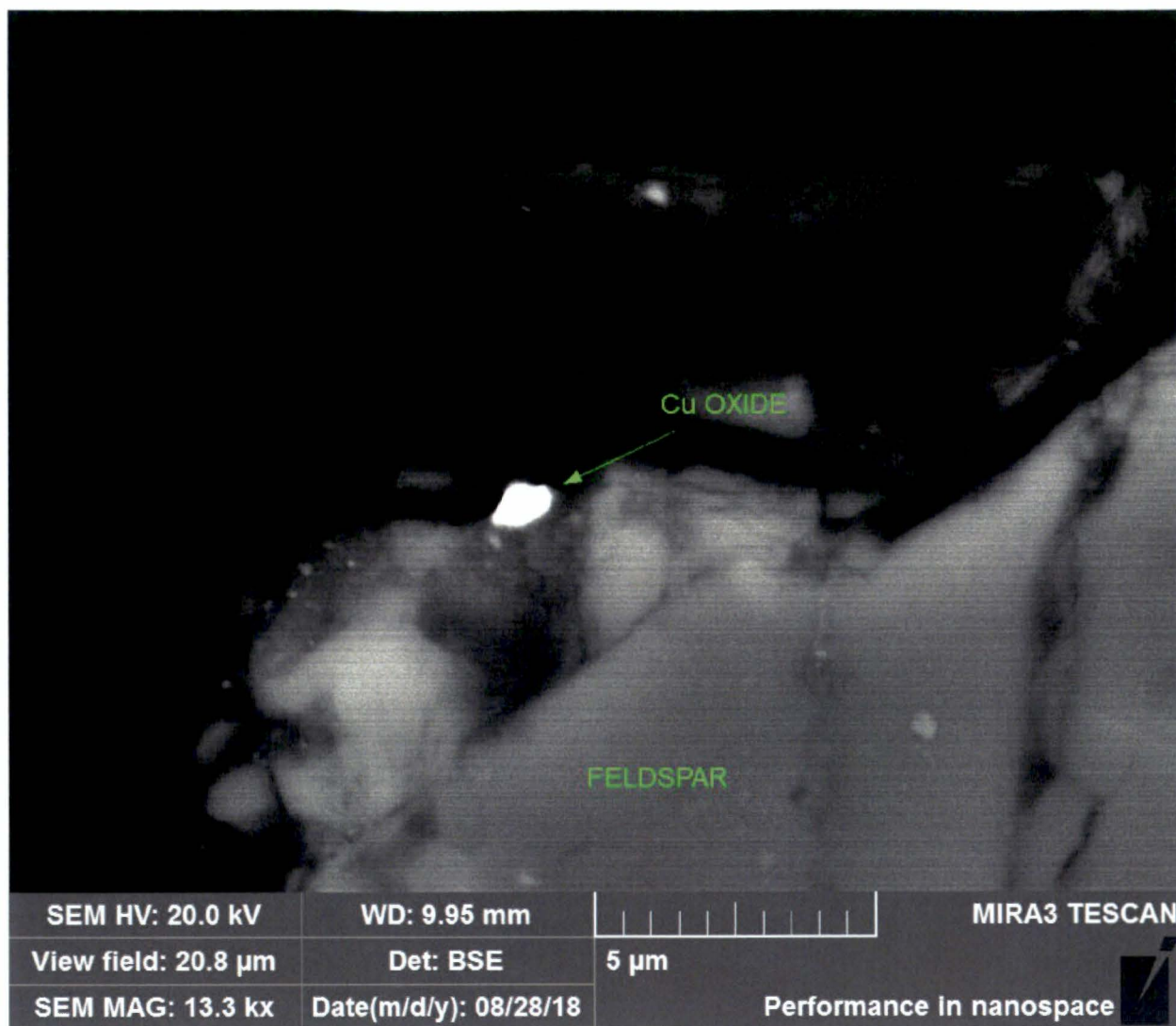
Backscatter image showing numerous cubes of bright pyrite in a multi-mineral rock fragment
1,630X



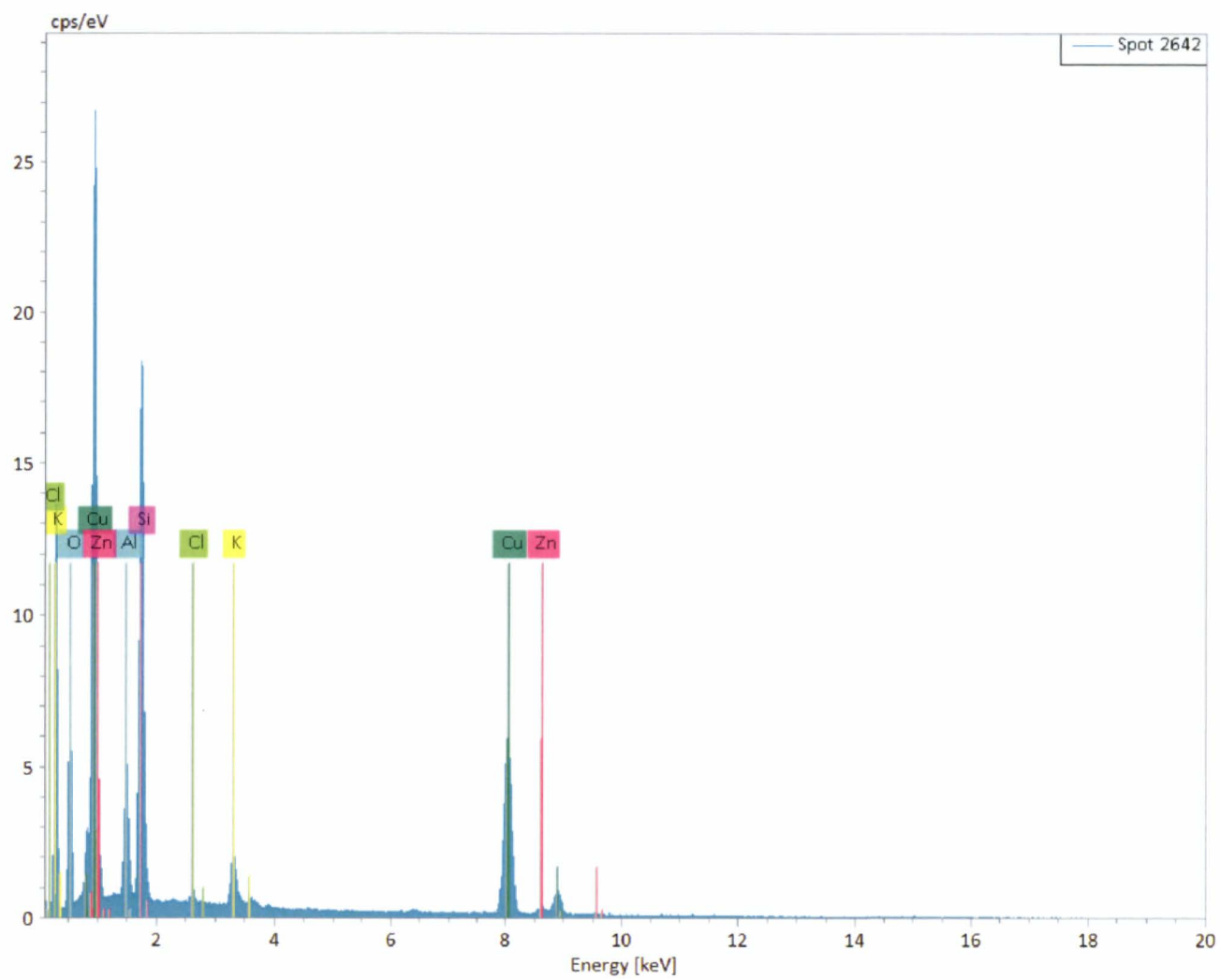


Client Sample No.: **WME-2**
Backscatter image showing bright grains of native Se in calcite – 2,910X





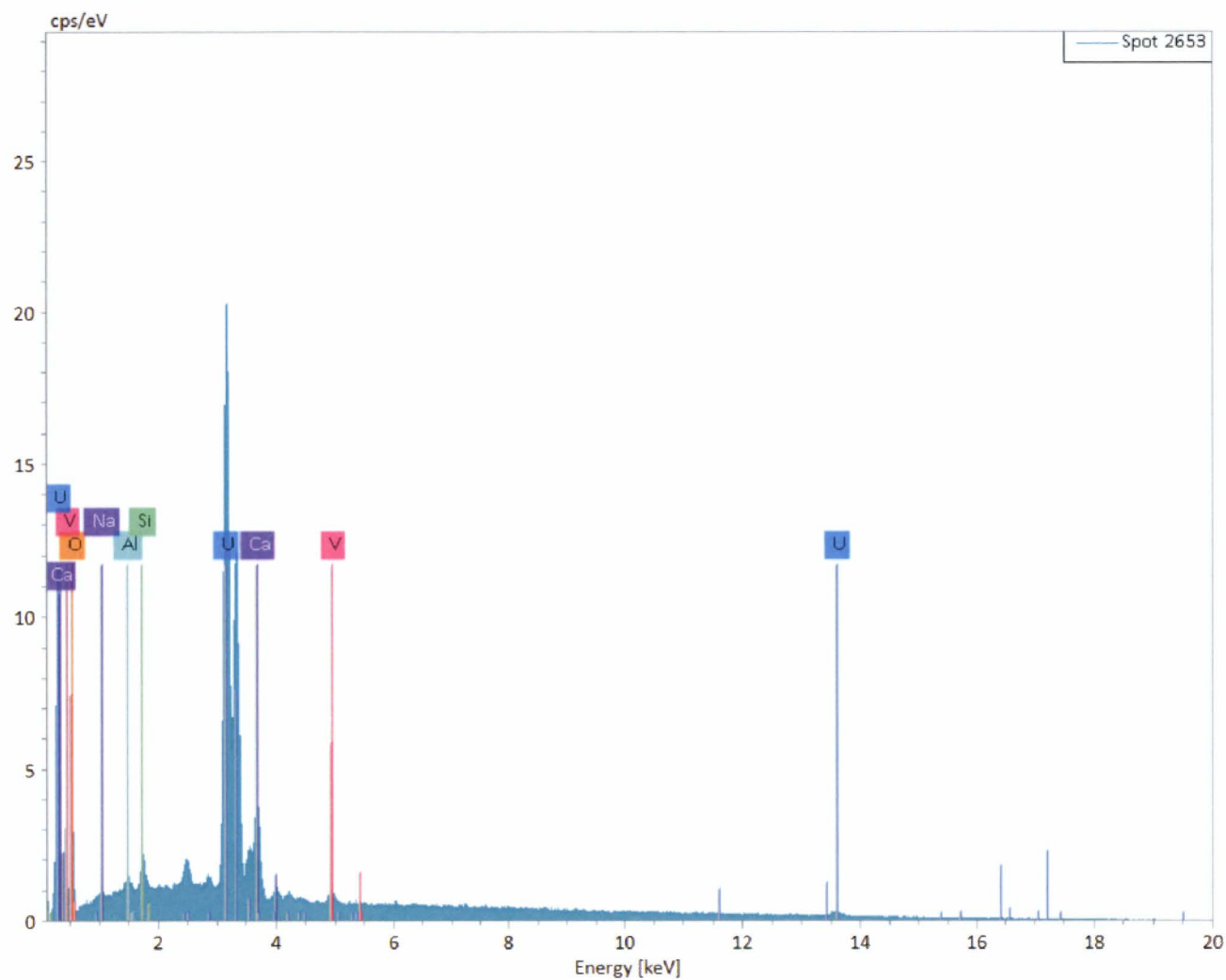
Client Sample No.: **WME-2**
Backscatter image of bright copper oxide in feldspar – 13,300X



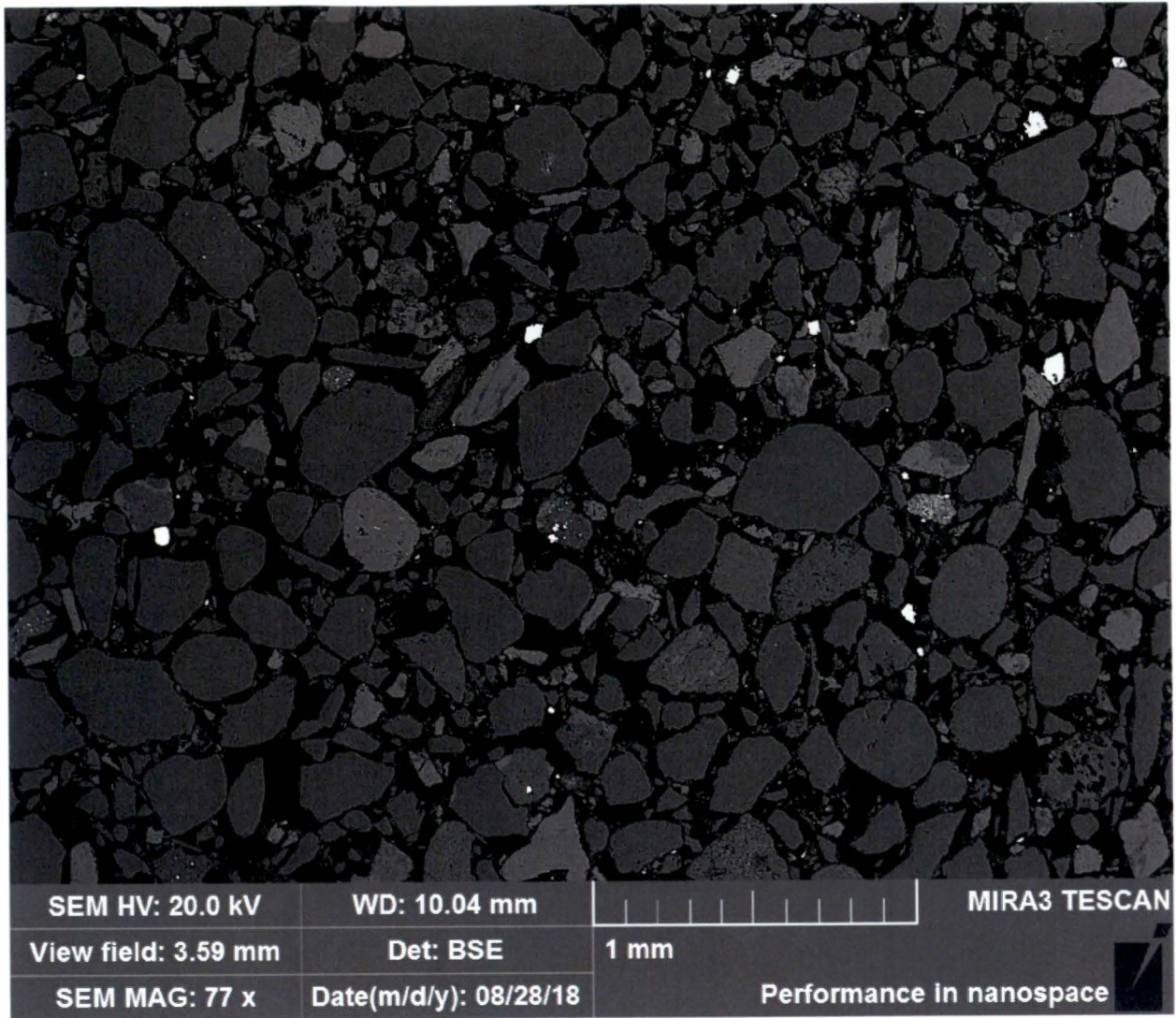


Client Sample No.: **WME-2**

Backscatter image shows a U phase attached to K-spar – 4,570X



Element	At. No.	Netto	Mass [%]	Mass Norm. [%]	Atom [%]	abs. error [%] (1 sigma)	rel. error [%] (1 sigma)
Oxygen	8	9088	5.77	10.27	47.87	0.84	14.63
Aluminium	13	2676	1.14	2.03	5.61	0.09	7.74
Silicon	14	5653	1.61	2.87	7.61	0.10	6.21
Calcium	20	17281	3.32	5.91	11.00	0.13	3.80
Vanadium	23	4315	1.54	2.74	4.02	0.07	4.85
Uranium	92	164409	42.81	76.19	23.88	1.33	3.11
		Sum	56.20	100.00	100.00		

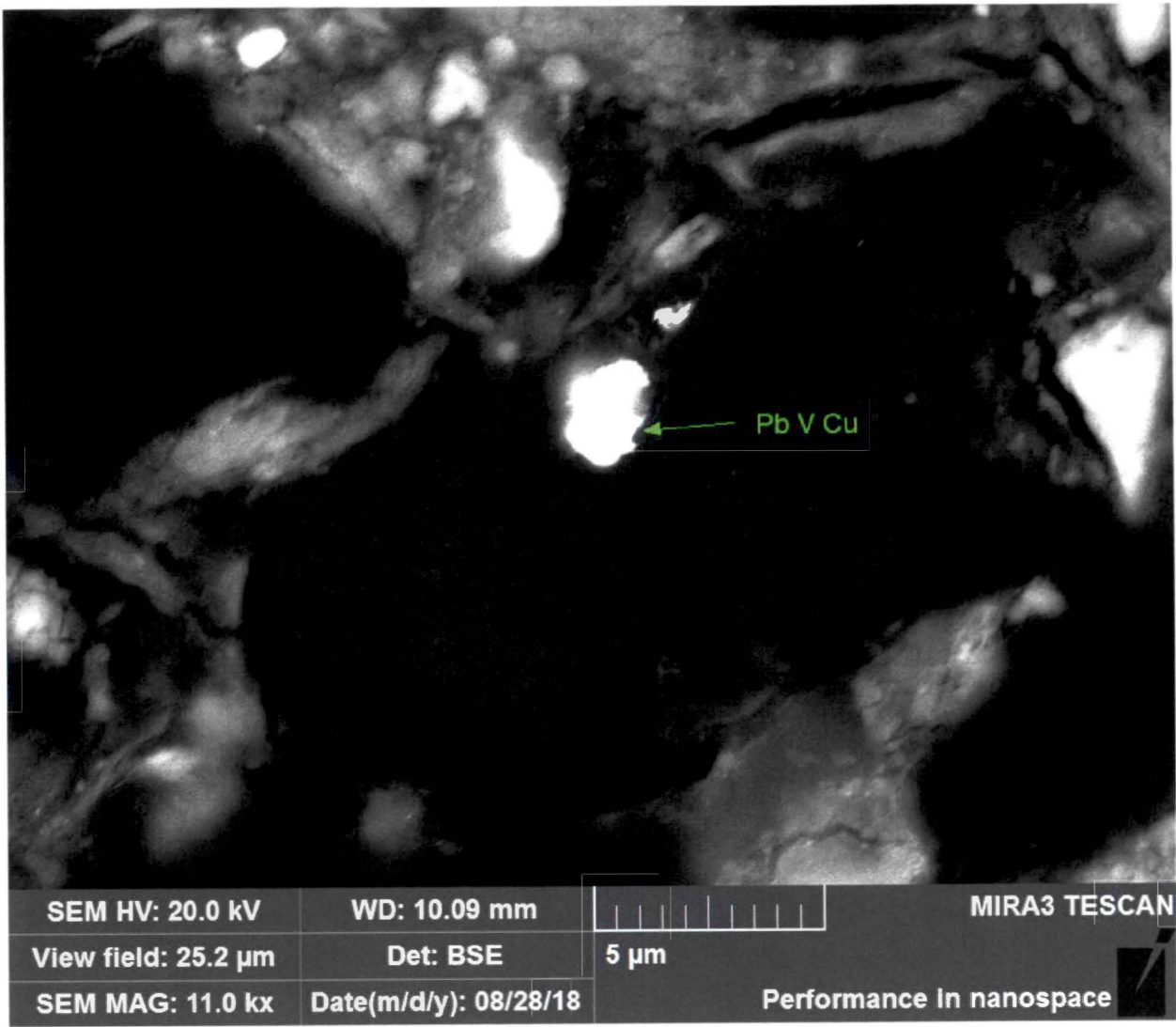


Client Sample No.: **WME-2**

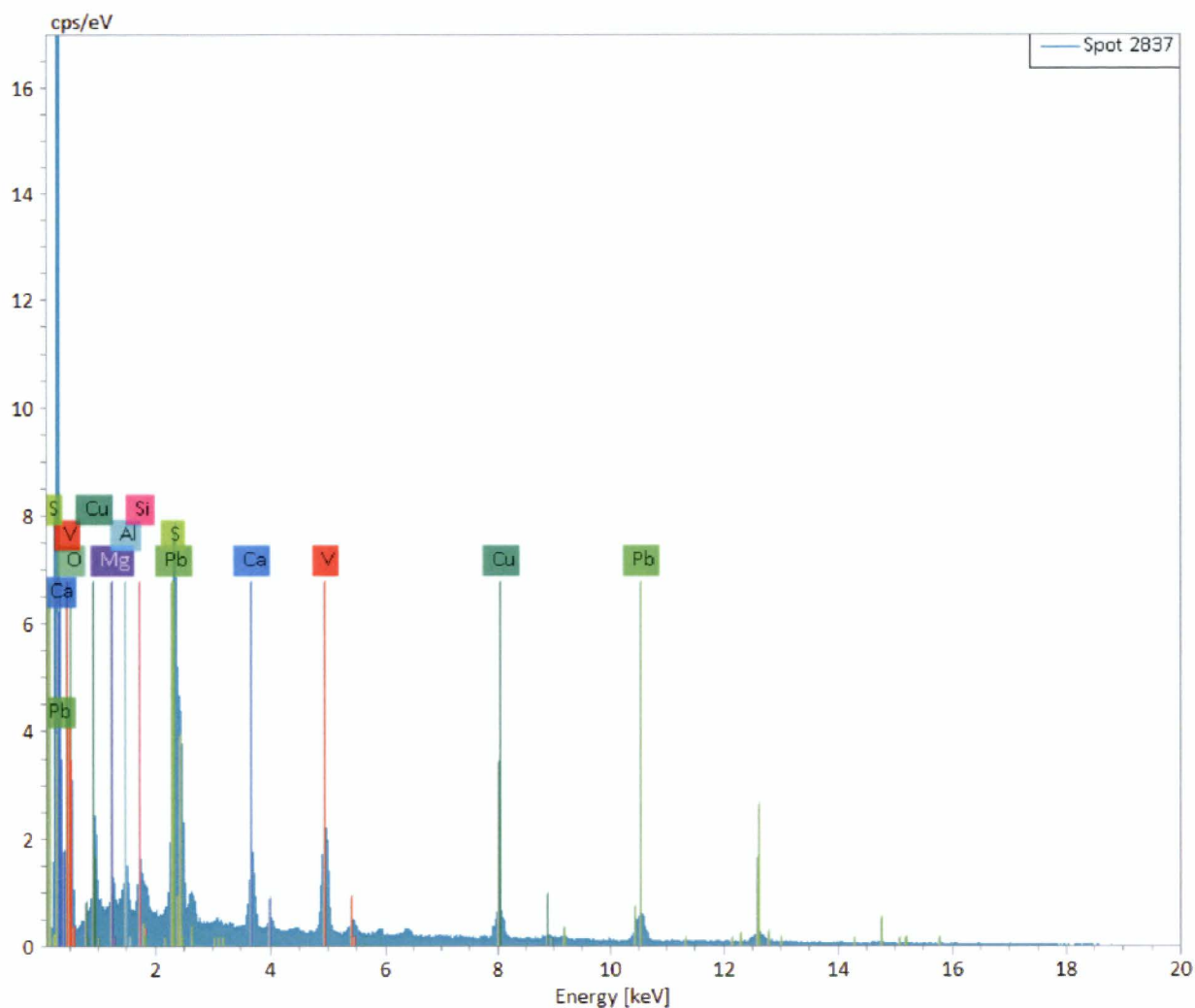
Low magnification backscatter image showing grain size distribution – 77X

Client Sample No.: **WME-3**

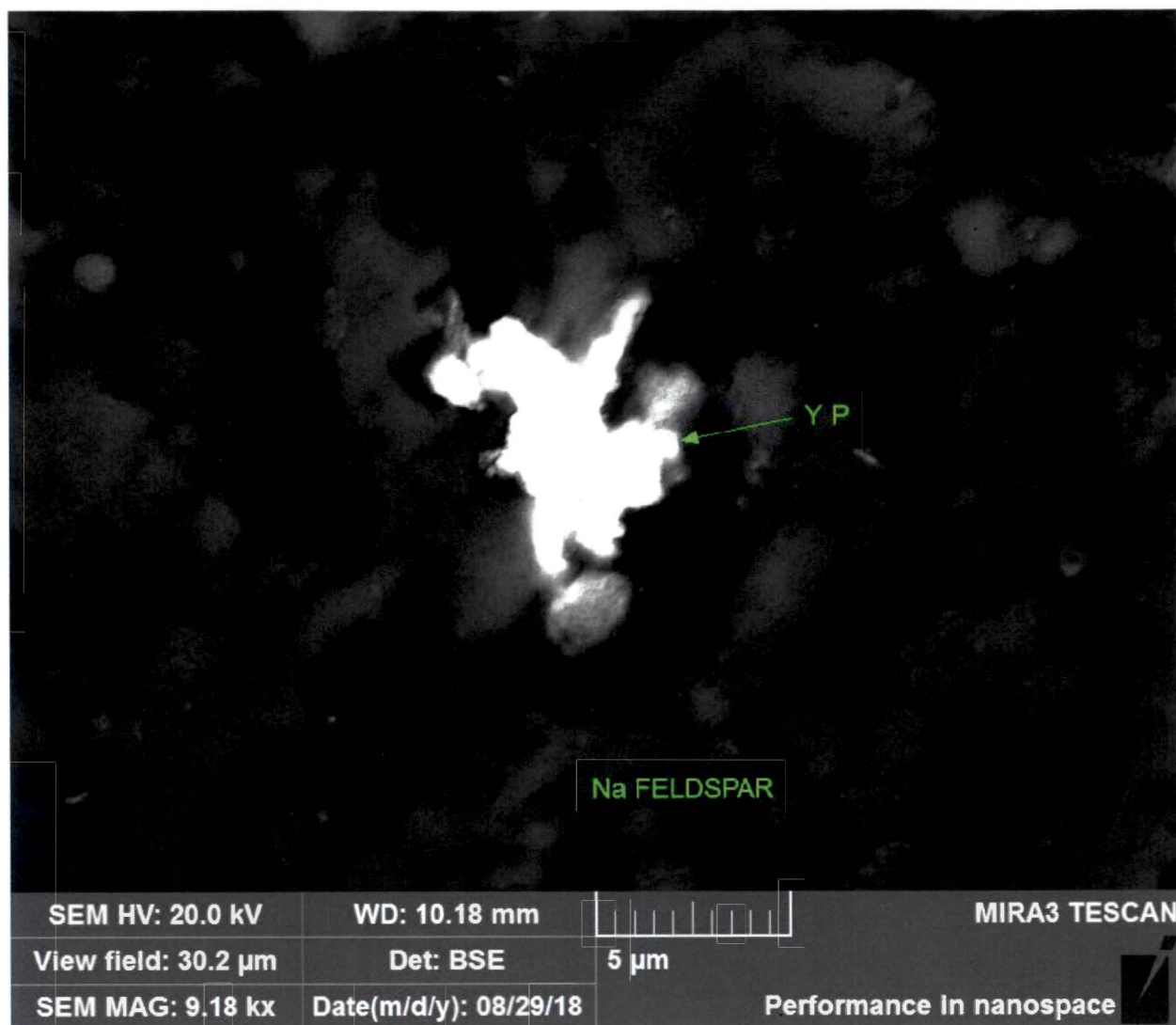
This sample is very similar to the previous sample **WME-2**. Texturally, the sample is a very fine to medium grained silty sand with some clay content. The bulk of the sediment is composed of hard silicates with quartz (~59%) as the primary type. Quartz occurs as angular to well rounded grains that vary from 5µm to 500µm in size. Collectively plagioclase and K-spar account for ~23% of the sample's mass. Plagioclase (~12%) occurs as angular to sub-angular fragments that measure from 5µm up to 250µm. Many of the grains exhibit corroded grain boundaries and intragrain pitting. K-spar (~11%) is angular to sub-rounded and has a similar grain size. The feldspars carry minute inclusions of barite, zircon and rare earth phosphates. Calcite (~8%) occurs as fine-grained aggregates and liberated grains up to 200µm. Clay minerals account for ~9% of the sample. XRD indicates kaolinite (~4%) is the primary type followed by swelling smectite (~2%), illite and chlorite at ~1% each. The clay minerals occur as grain coatings on silicates and small mixed masses with silt. Pyrite is the main sulfide and occurs as small liberated grains and euhedral cubes included in some of the quartz/feldspar. Chalcopyrite is present as a trace and occurs as minute inclusions in a small population of the hard silicates. Oxide mineralogy includes hematite, rutile, magnetite, and a rare Cu-Sn oxide. Selenides are present as a trace and include native Se, Fe selenide and a rare Pb-Cu selenide with low to moderate V content. Two examples of U bearing phases were identified. A grain of yttrium phosphate assumed to be xenotime, occurs as a small 6µm amoeba shaped inclusion in a pitted grain of plagioclase. EDS x-ray microanalysis of the grain in several areas confirms the presence of U, V, and significant As. Intermixed with clay/silt, a small liberated, 2.5µm grain composed primarily of U-Ti was identified.



Client Sample No.: **WME-3**
Backscatter image of a bright Pb-V-Cu phase – 11,000X

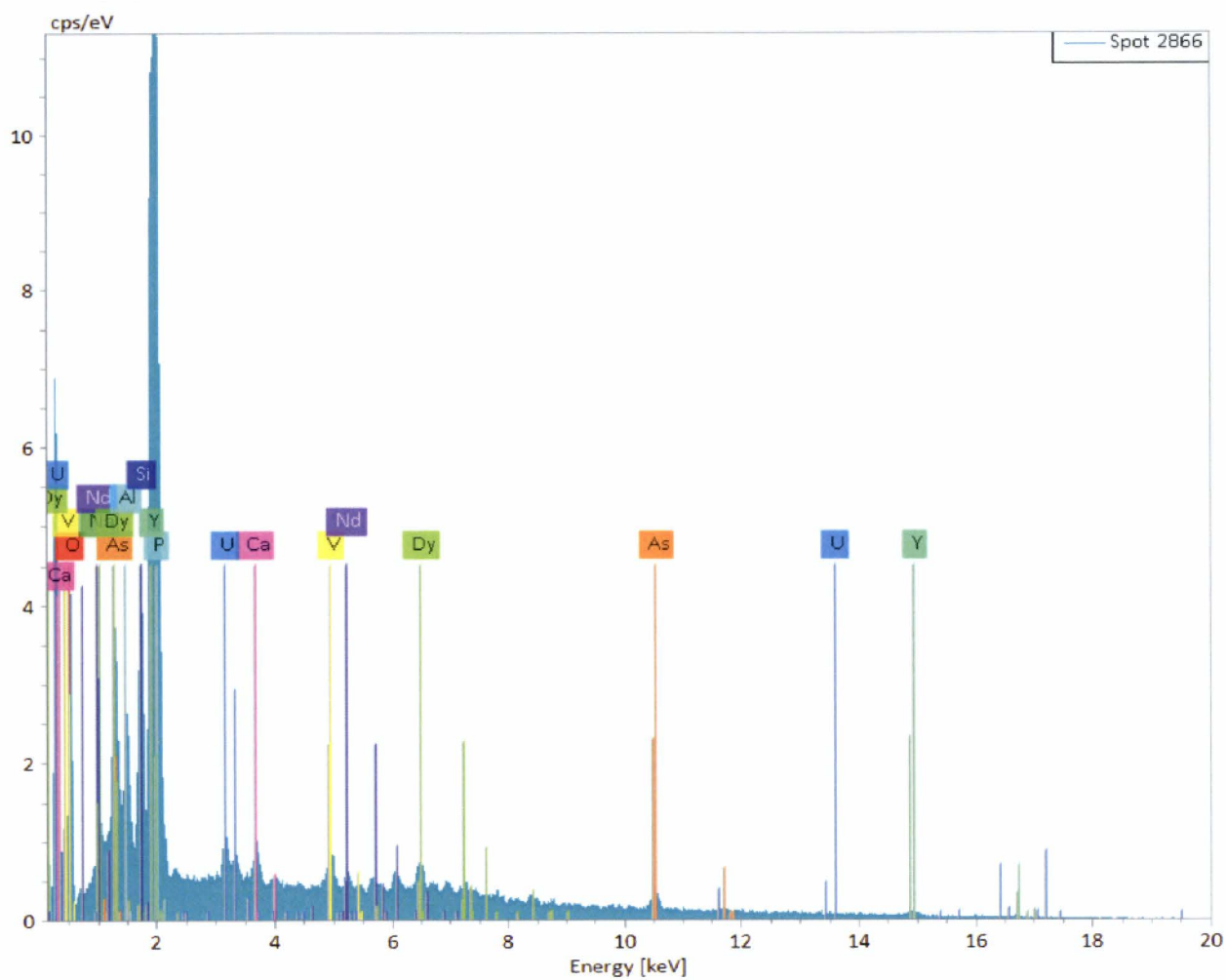


Element	At. No.	Netto	Mass [%]	Mass Norm. [%]	Atom [%]	abs. error [%] (1 sigma)	rel. error [%] (1 sigma)
Oxygen	8	9111	16.81	26.86	70.26	2.41	14.34
Magnesium	12	0	0.00	0.00	0.00	0.00	3.46
Aluminium	13	0	0.00	0.00	0.00	0.00	2.77
Silicon	14	90	0.01	0.01	0.02	0.00	13.00
Calcium	20	8517	2.67	4.26	4.45	0.11	4.12
Vanadium	23	13264	7.20	11.51	9.46	0.23	3.24
Copper	29	4779	5.36	8.57	5.64	0.19	3.60
Lead	82	6538	30.34	48.48	9.79	1.03	3.41
Sulfur	16	2140	0.19	0.30	0.39	0.03	17.95
		Sum	62.57	100.00	100.00		

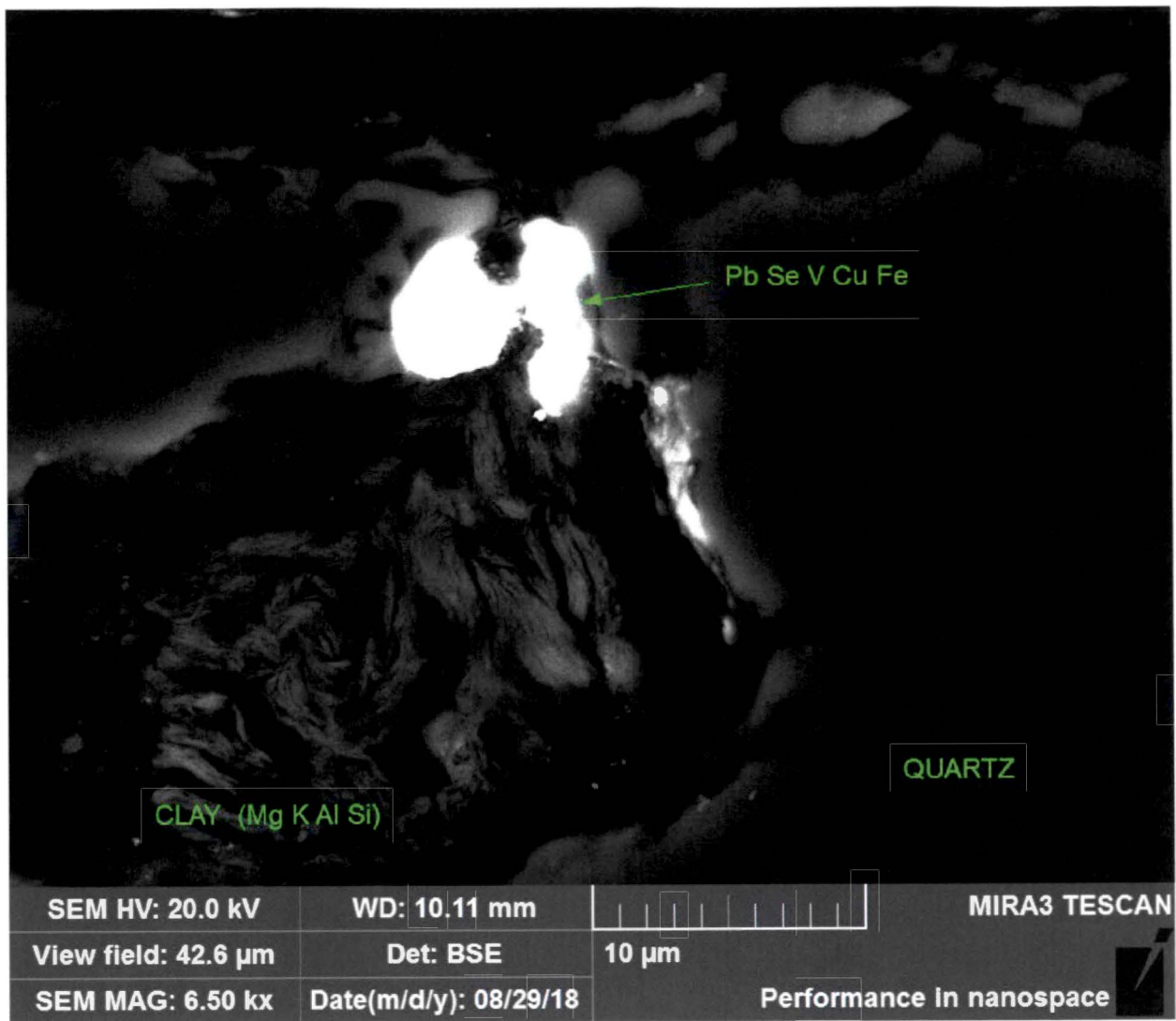


Client Sample No.: **WME-3**

Backscatter image of xenotime (?) associated with U and V in plagioclase feldspar – 9,180X

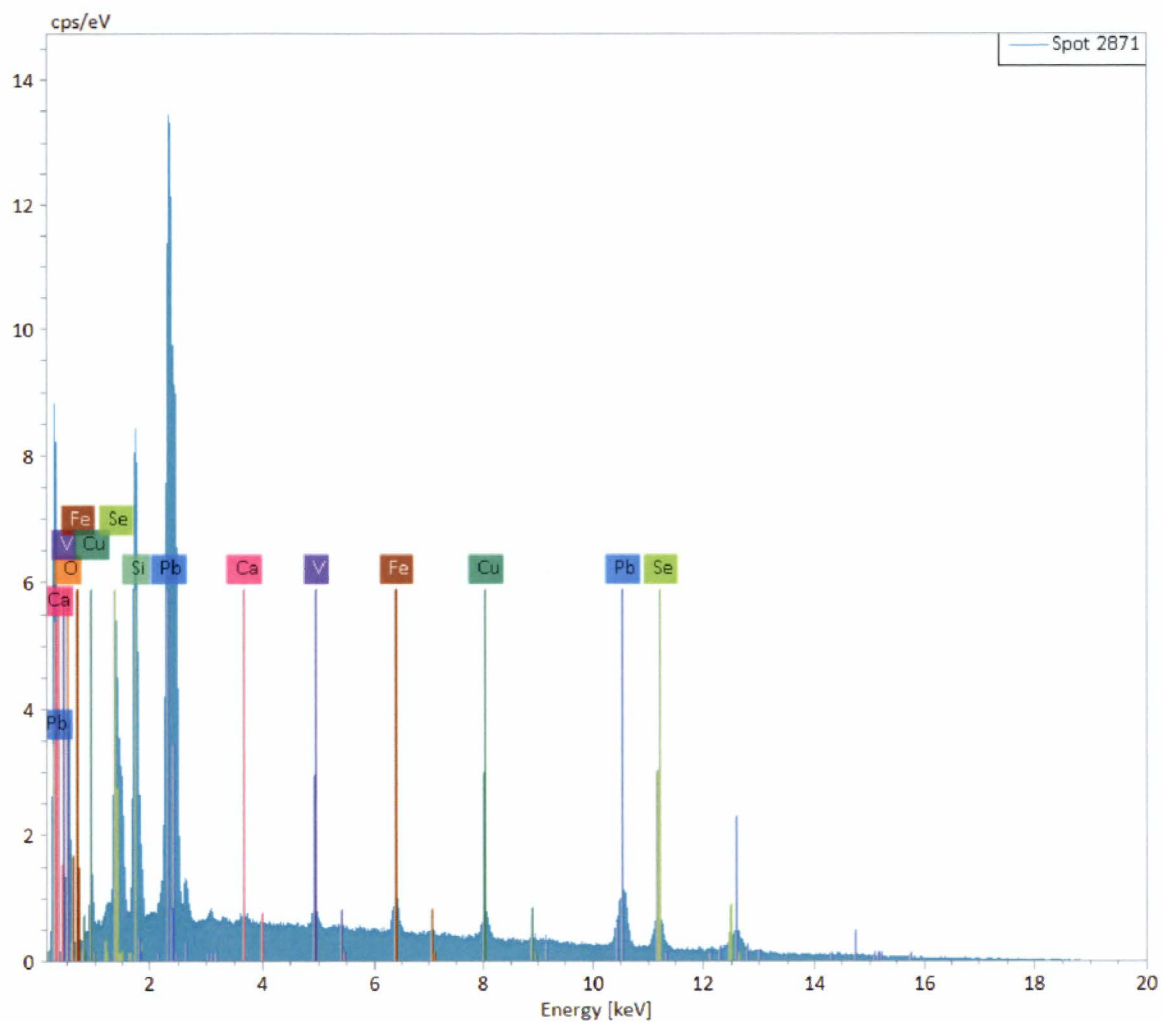


Element	At. No.	Netto	Mass [%]	Mass Norm. [%]	Atom [%]	abs. error [%] (1 sigma)	rel. error [%] (1 sigma)
Oxygen	8	15581	15.51	25.44	55.93	2.07	13.37
Sodium	11	1961	0.54	0.88	1.35	0.07	12.09
Phosphorus	15	46569	7.03	11.53	13.10	0.30	4.27
Calcium	20	4308	0.97	1.60	1.40	0.06	5.99
Vanadium	23	4186	1.07	1.75	1.21	0.06	5.59
Arsenic	33	2537	3.55	5.82	2.73	0.15	4.37
Yttrium	39	878	21.16	34.70	13.73	1.33	6.31
Neodymium	60	3312	1.22	2.00	0.49	0.07	5.36
Dysprosium	66	6280	2.78	4.56	0.99	0.11	3.91
Uranium	92	6922	3.18	5.21	0.77	0.13	4.16
Aluminium	13	9914	1.75	2.87	3.74	0.11	6.44
Silicon	14	16986	2.22	3.64	4.56	0.12	5.52
		Sum	60.99	100.00	100.00		

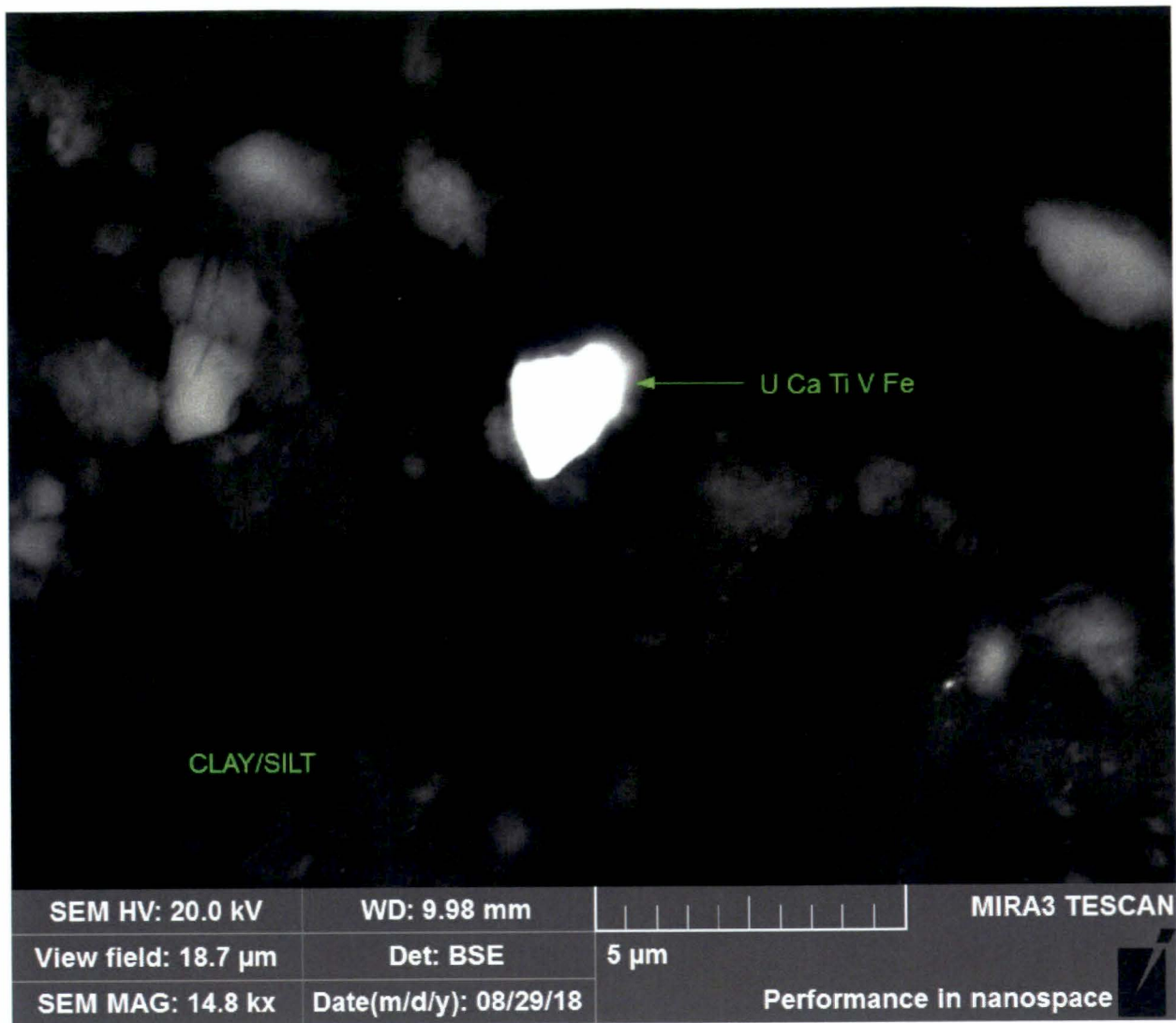


Client Sample No.: **WME-3**

Backscatter image showing a bright grain composed primarily of Pb with lesser amounts of Se, V, Cu and Fe next to a small vug filled with clay in quartz – 6,500X

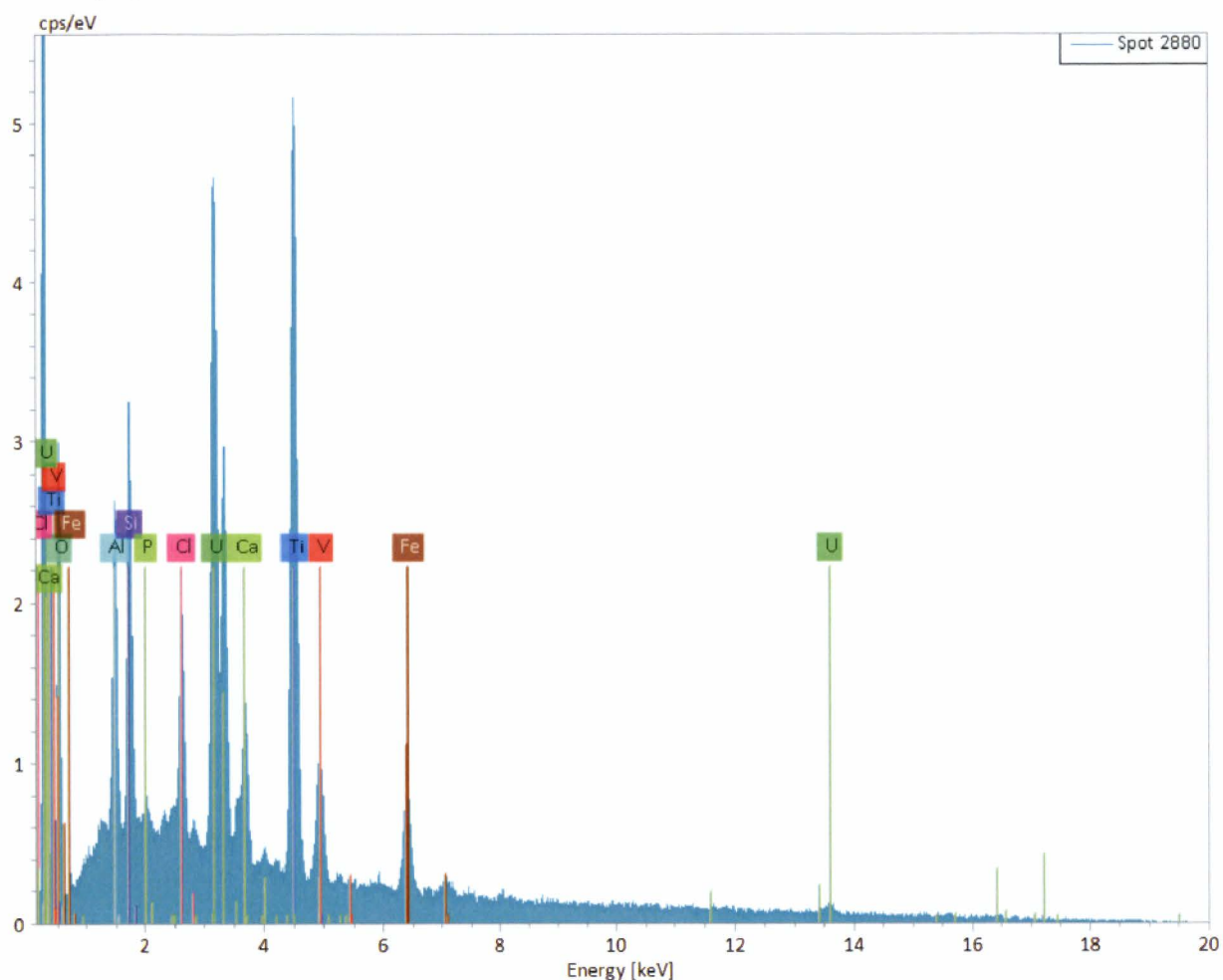


Element	At. No.	Netto	Mass [%]	Mass Norm. [%]	Atom [%]	abs. error [%] (1 sigma)	rel. error [%] (1 sigma)
Oxygen	8	15085	13.25	17.02	55.37	1.78	13.45
Silicon	14	40352	6.25	8.03	14.88	0.29	4.72
Vanadium	23	2240	0.59	0.75	0.77	0.05	7.88
Iron	26	5240	1.72	2.21	2.06	0.08	4.53
Copper	29	5260	2.67	3.43	2.81	0.11	4.03
Selenium	34	7399	12.47	16.01	10.56	0.43	3.44
Lead	82	16944	40.68	52.23	13.12	1.29	3.18
Calcium	20	1056	0.26	0.33	0.43	0.04	14.19
		Sum	77.90	100.00	100.00		

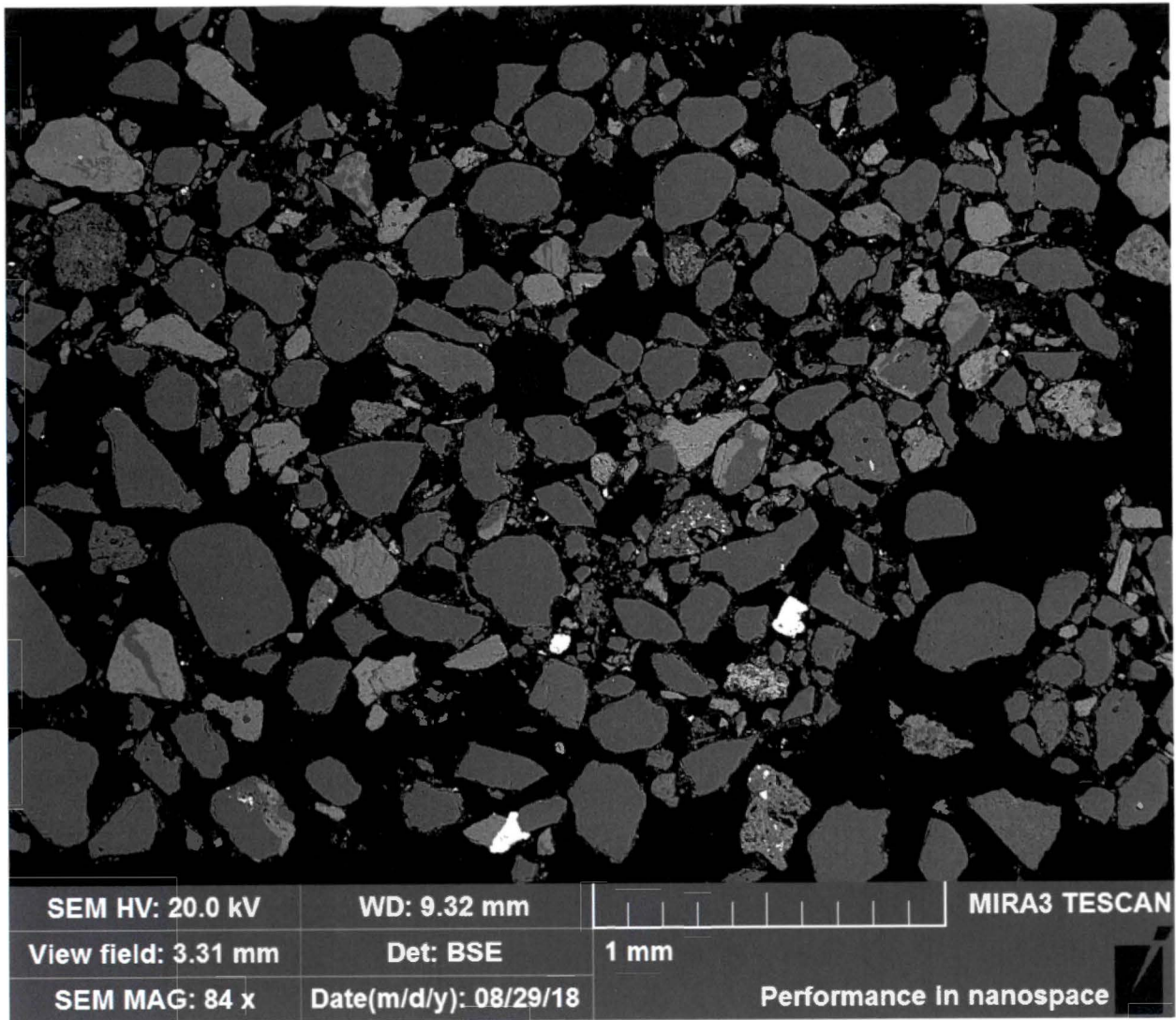


Client Sample No.: **WME-3**

Backscatter image showing a bright liberated grain composed primarily of U and Ti – 14,800X



Element	At. No.	Netto	Mass [%]	Mass Norm. [%]	Atom [%]	abs. error [%] (1 sigma)	rel. error [%] (1 sigma)
Oxygen	8	10311	13.03	21.87	52.39	1.84	14.13
Aluminium	13	10031	2.29	3.85	5.47	0.14	6.09
Silicon	14	13663	2.20	3.70	5.05	0.12	5.56
Chlorine	17	7926	1.32	2.21	2.39	0.07	5.54
Calcium	20	7576	1.90	3.19	3.05	0.09	4.53
Titanium	22	41171	15.69	26.33	21.08	0.47	2.98
Vanadium	23	1462	0.57	0.96	0.72	0.05	8.36
Iron	26	6631	4.05	6.79	4.66	0.15	3.61
Uranium	92	46238	18.44	30.94	4.98	0.60	3.23
Phosphorus	15	540	0.10	0.16	0.20	0.03	32.58
		Sum	59.60	100.00	100.00		

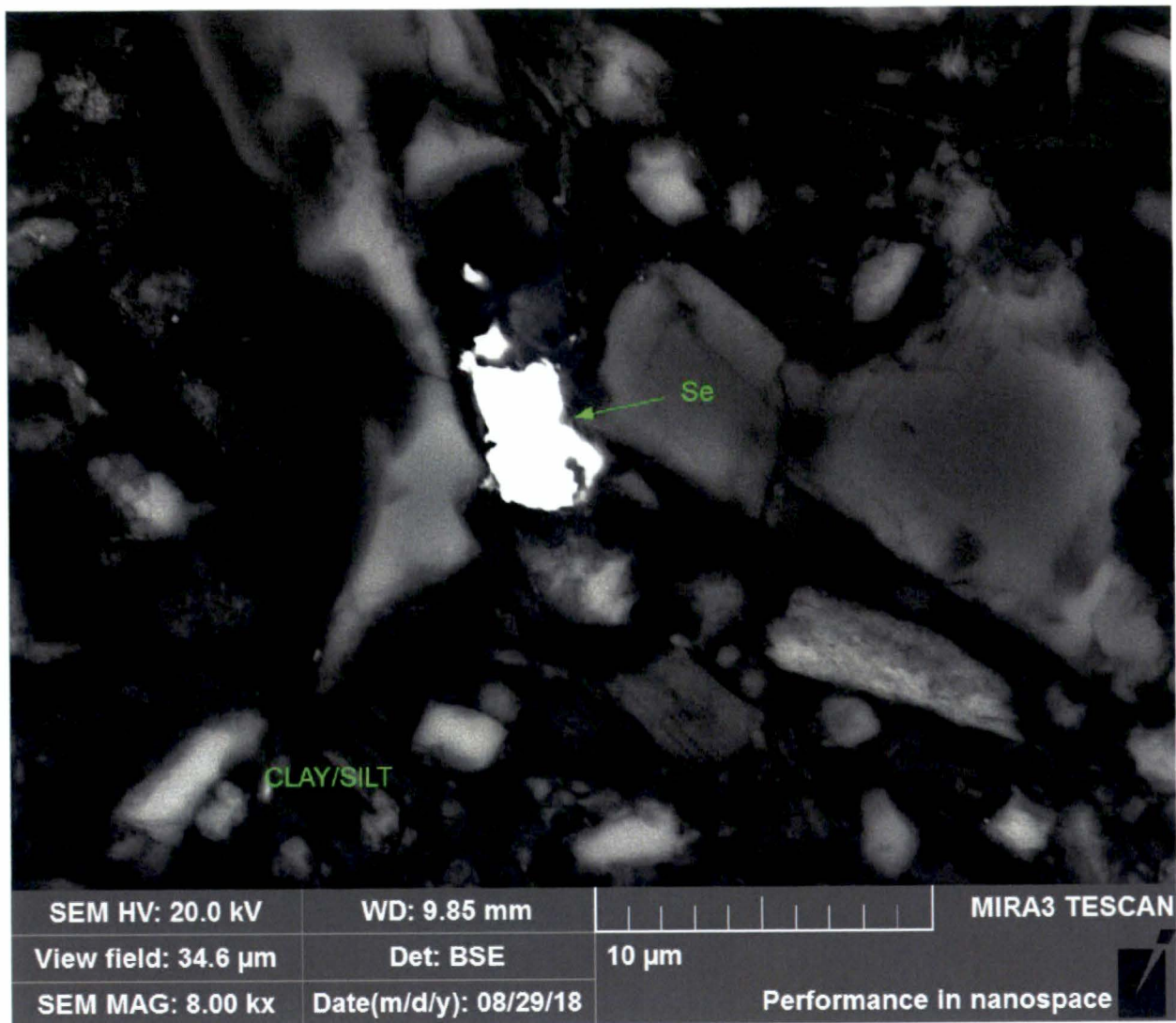


Client Sample No.: **WME-3**

Low magnification backscatter image showing grain size distribution – 84X

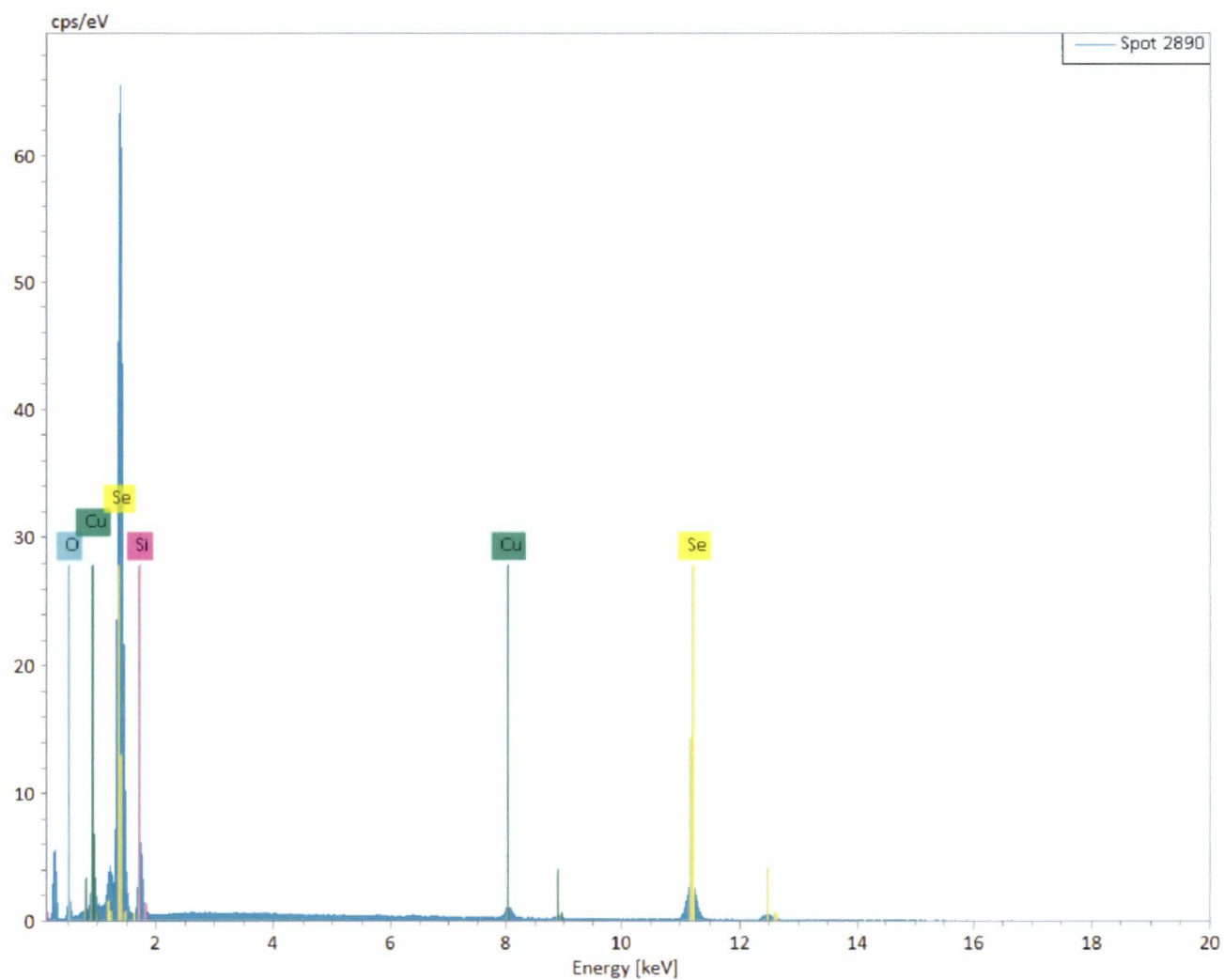
Client Sample No.: **WME-5**

This sample is a grey colored sediment with a clayey silt texture. Clay accounts for >20% of the sample's mass and is identified by XRD as primarily kaolinite (~10%), swelling smectite (~9%) and lesser amounts of chlorite (~2%) and illite (~2%). Quartz (~45%) is the primary hard silicate and occurs as angular to rounded grains that vary significantly in size from 2 μ m to 300 μ m. Plagioclase and K-spar are present in like amounts (~12%) and occur as angular fragments in the 2 μ m to 75 μ m size range. Calcite accounts for ~8% of the sample and occurs as very fine dispersed grains in the 2 μ m to 100 μ m size range. Pyrite up to 20 μ m in size is the only sulfide identified and accounts for ~1% of the sample. Other mineral phases include zircon, monazite, rutile, iron oxide and barite in trace amounts. One grain of monazite carries elevated Th in addition to its typical REE of Ce, La and Nd. Of the sediments studied, this sample carries the highest concentration of selenides represented by several types. Native Se is the most prominent and occurs as irregularly shaped, liberated grains that vary from <1 μ m up to 50 μ m in size. Cu-Se is the next most abundant and occurs as small liberated grains in the <1 μ m to 10 μ m size range. A few small liberated grains of Pb-Se were also detected. A small 1 μ m grain of Pb-V was identified in a mass of clay. Two round grains of U were identified and occur as minute 0.1 μ m to 0.2 μ m inclusions in a large grain of native Se.

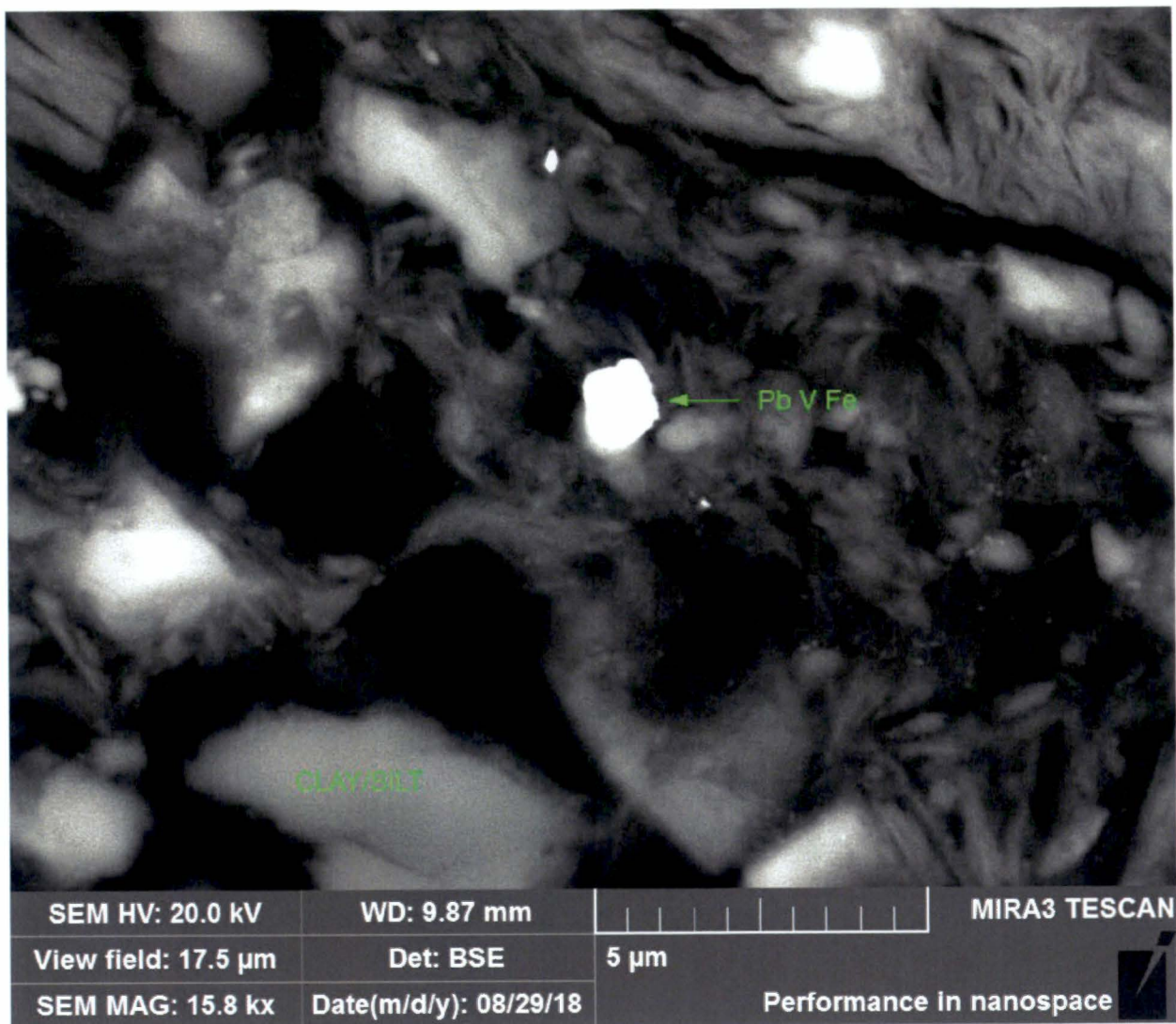


Client Sample No.: **WME-5**

Backscatter image showing a bright grain on native Se in a clay/silt matrix – 8,000X

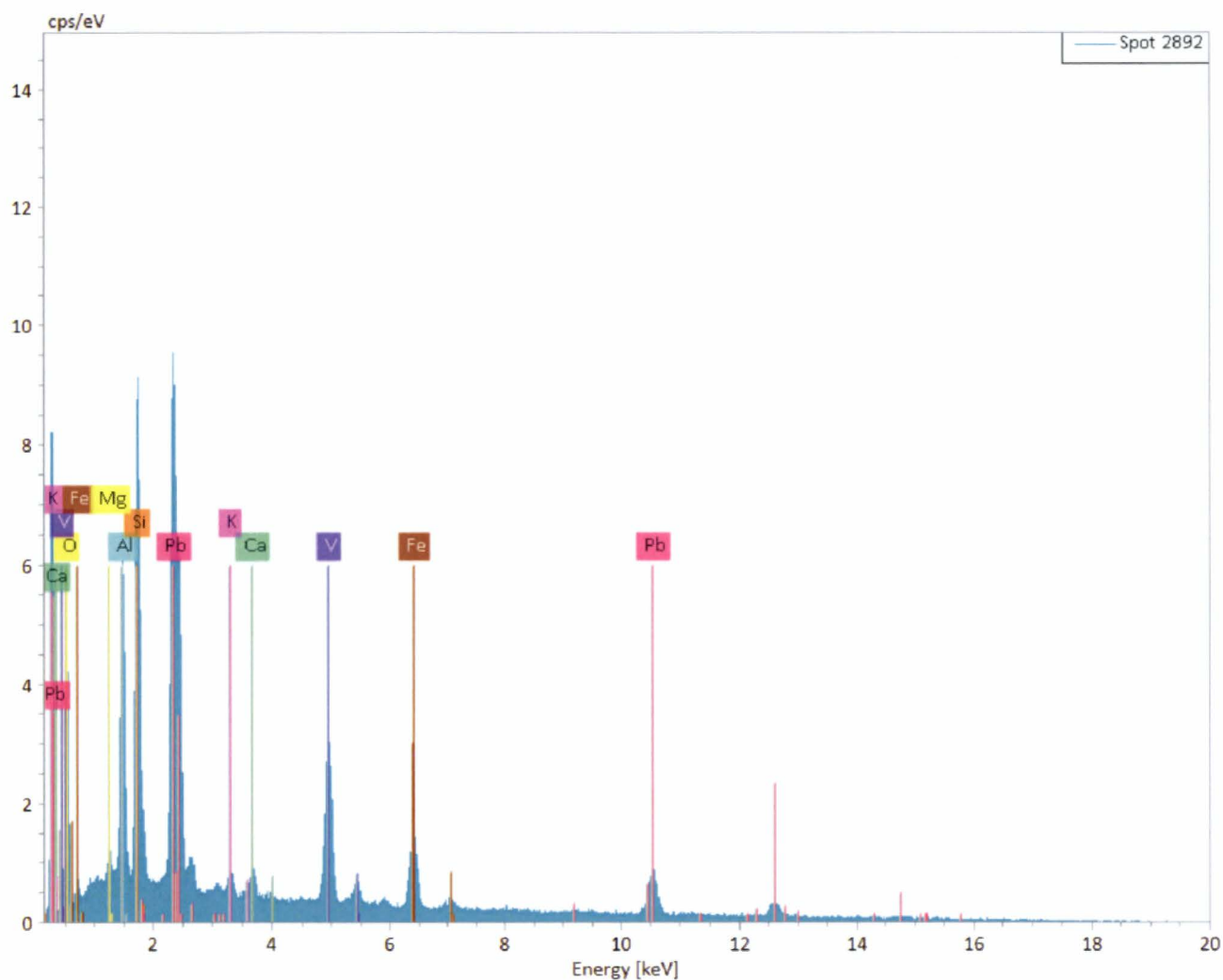


Element	At. No.	Netto	Mass [%]	Mass Norm. [%]	Atom [%]	abs. error [%] (1 sigma)	rel. error [%] (1 sigma)
Oxygen	8	3367	6.11	6.77	23.25	1.06	17.30
Silicon	14	15215	7.91	8.77	17.15	0.37	4.73
Copper	29	4493	4.37	4.85	4.19	0.16	3.73
Selenium	34	18896	71.82	79.62	55.41	2.22	3.09
		Sum	90.20	100.00	100.00		

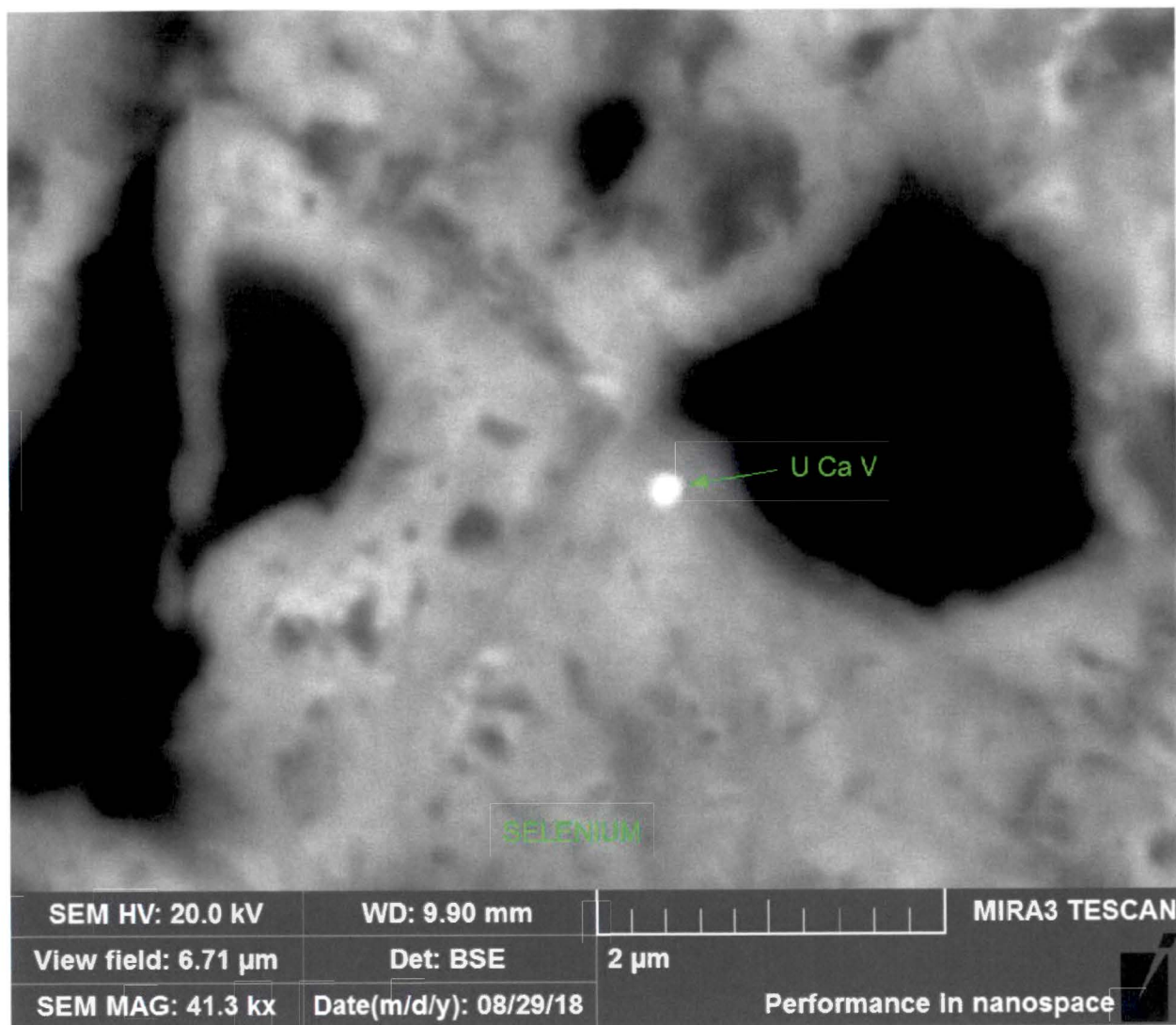


Client Sample No.: **WME-5**

Backscatter image of a bright Pb-V-Fe phase in a body of clay – 15,800X

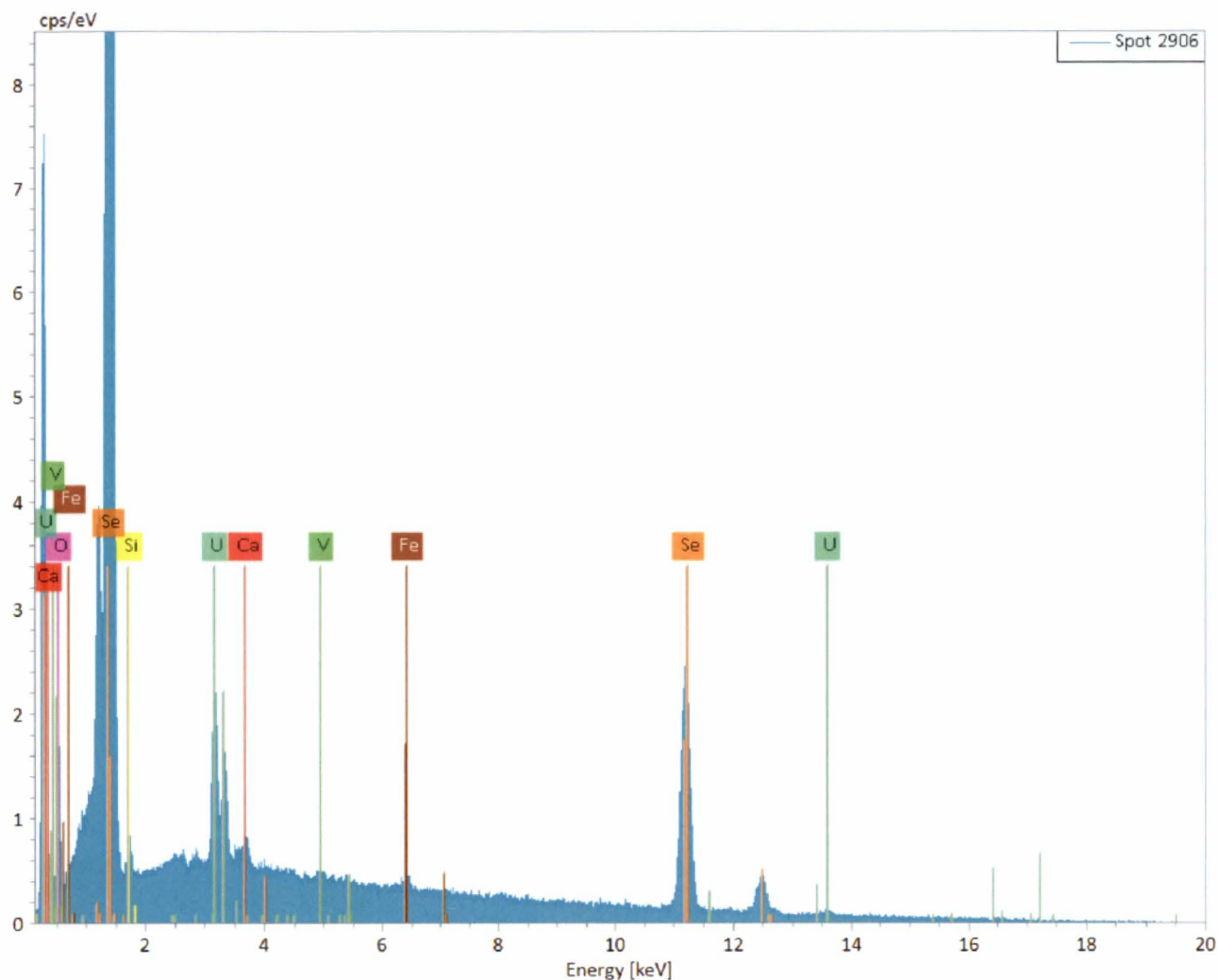


Element	At. No.	Netto	Mass [%]	Mass Norm. [%]	Atom [%]	abs. error [%] (1 sigma)	rel. error [%] (1 sigma)
Oxygen	8	14029	23.78	24.36	57.25	3.21	13.48
Aluminium	13	19617	6.81	6.97	9.72	0.36	5.26
Silicon	14	32937	8.46	8.67	11.61	0.39	4.62
Calcium	20	2223	0.99	1.01	0.95	0.06	6.35
Vanadium	23	18147	8.35	8.55	6.31	0.26	3.14
Iron	26	9501	6.64	6.80	4.58	0.22	3.27
Lead	82	8952	41.11	42.10	7.64	1.36	3.30
Potassium	19	1840	0.73	0.75	0.72	0.05	7.53
Magnesium	12	1675	0.77	0.79	1.22	0.08	9.88
		Sum	97.63	100.00	100.00		

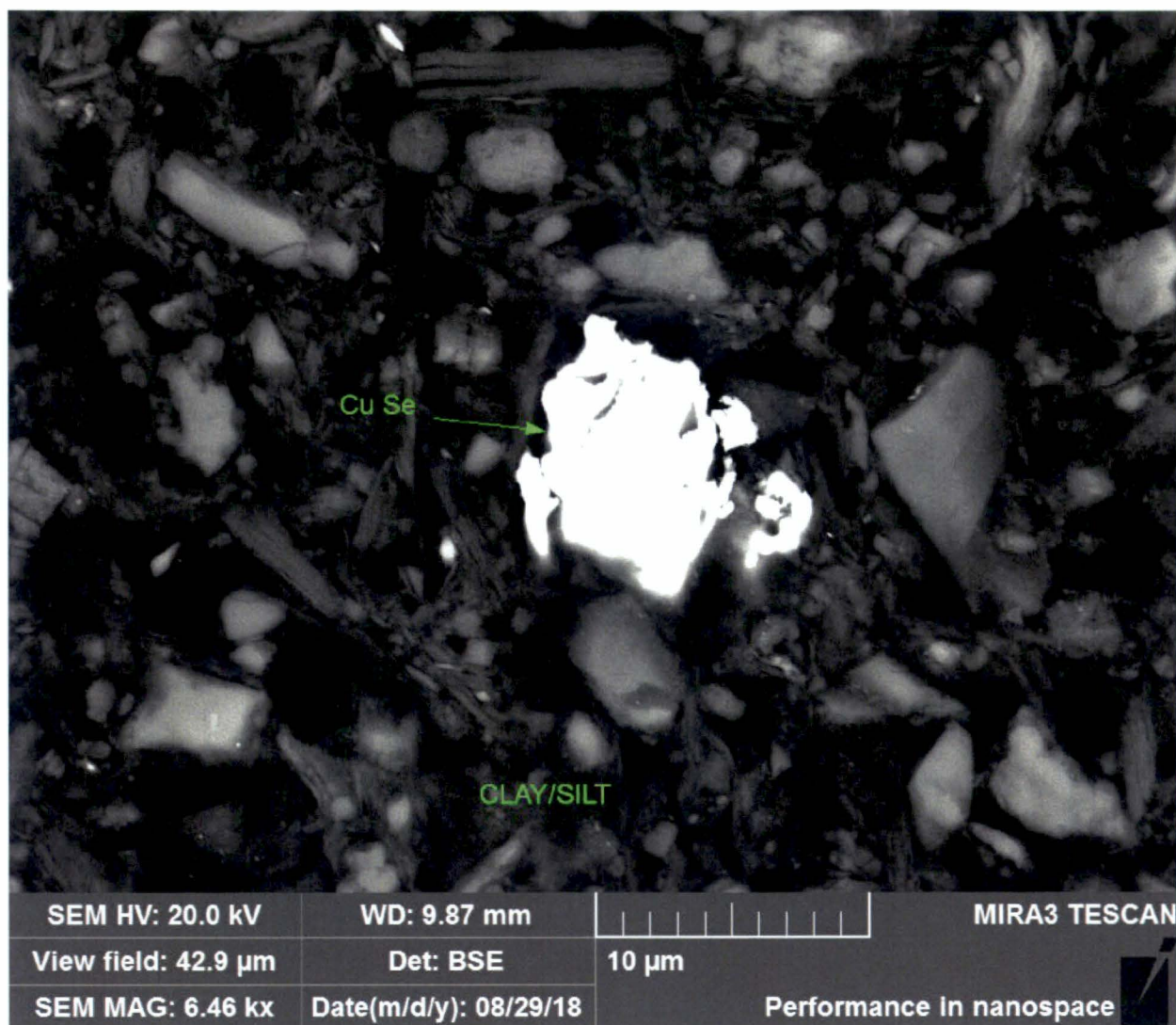


Client Sample No.: **WME-5**

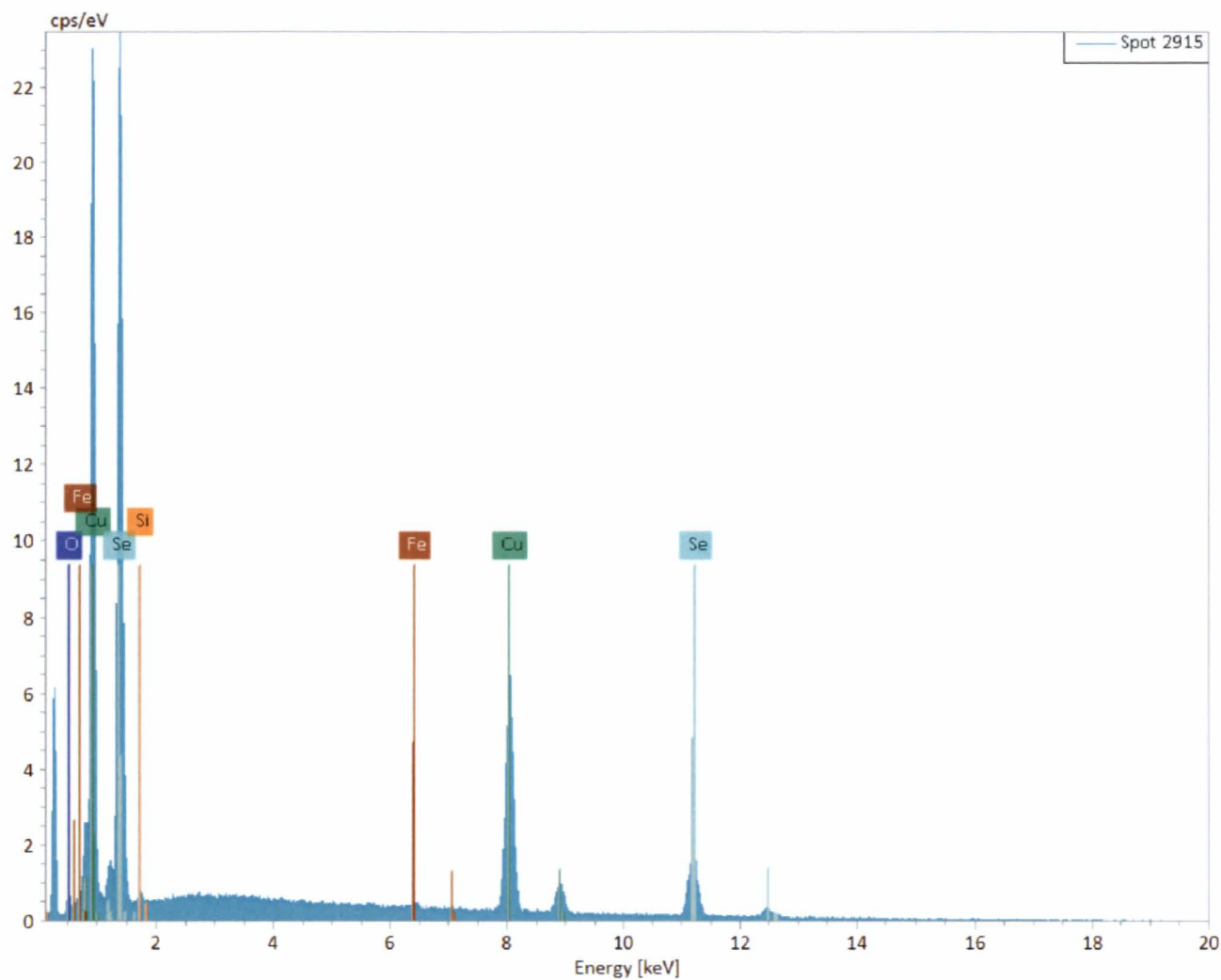
Backscatter image showing a bright, minute grain of U in a matrix of native Se – 41,300X



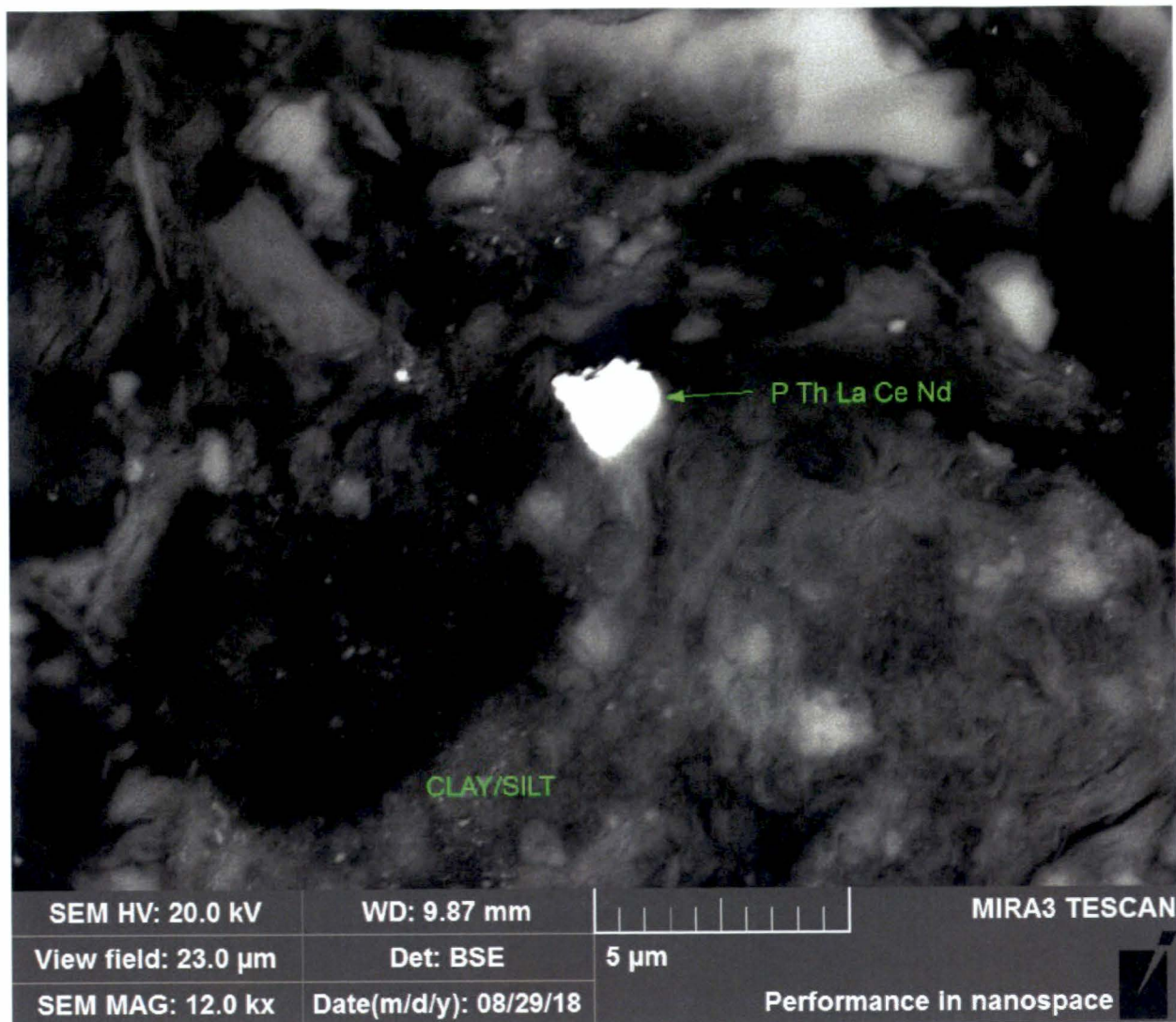
Element	At. No.	Netto	Mass [%]	Mass Norm. [%]	Atom [%]	abs. error [%] (1 sigma)	rel. error [%] (1 sigma)
Oxygen	8	6628	6.83	7.98	31.14	1.04	15.28
Silicon	14	1839	0.54	0.63	1.39	0.05	9.98
Selenium	34	31844	68.44	79.89	63.21	2.08	3.04
Uranium	92	20407	8.88	10.36	2.72	0.31	3.44
Calcium	20	2083	0.45	0.53	0.83	0.04	9.38
Iron	26	1003	0.38	0.44	0.49	0.04	11.01
Vanadium	23	555	0.15	0.18	0.22	0.03	22.01
		Sum	85.67	100.00	100.00		



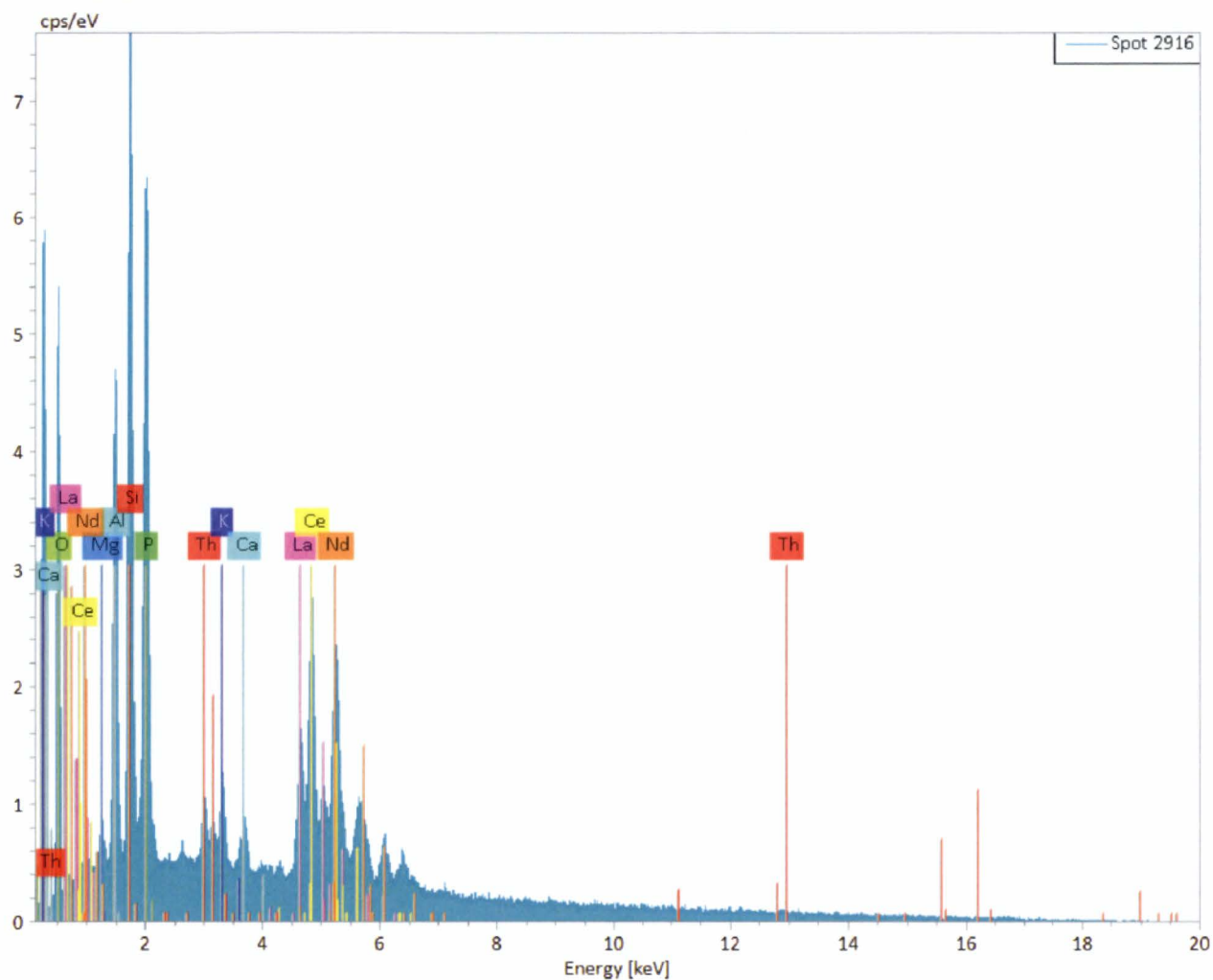
Client Sample No.: **WME-5**
Backscatter image of bright Cu selenide in a clay/silt matrix – 6,640X



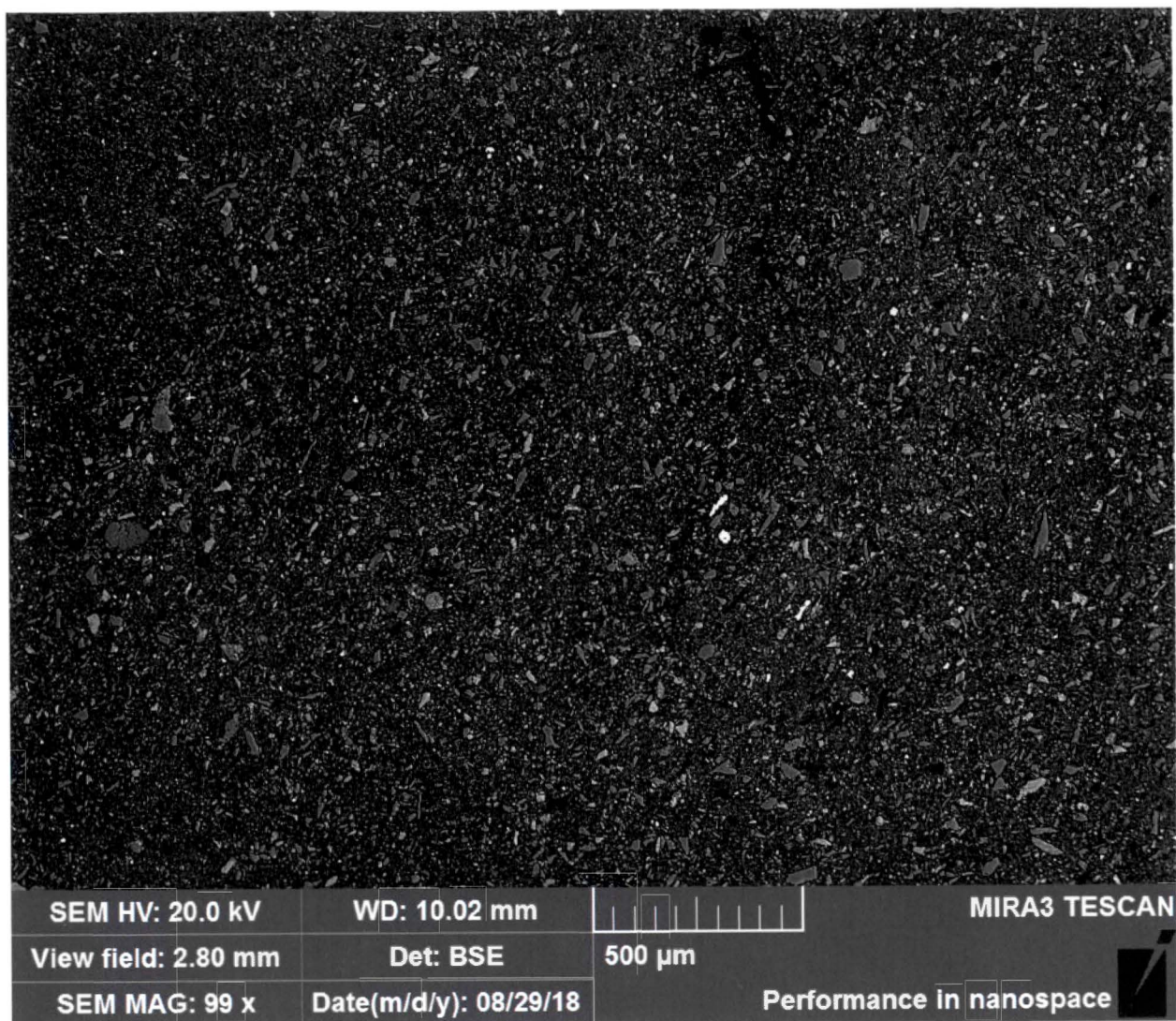
Element	At. No.	Netto	Mass [%]	Mass Norm. [%]	Atom [%]	abs. error [%] (1 sigma)	rel. error [%] (1 sigma)
Oxygen	8	827	1.35	1.60	6.73	0.35	25.76
Copper	29	35820	37.31	44.25	46.84	1.05	2.80
Selenium	34	11721	45.17	53.56	45.63	1.44	3.19
Iron	26	724	0.42	0.50	0.61	0.05	10.76
Silicon	14	136	0.07	0.08	0.19	0.03	47.74
		Sum	84.32	100.00	100.00		



Client Sample No.: **WME-5**
Backscatter image of monazite with Th in clay – 12,000X



Element	At. No.	Netto	Mass [%]	Mass Norm. [%]	Atom [%]	abs. error [%] (1 sigma)	rel. error [%] (1 sigma)
Thorium	90	4626	1.87	2.93	0.47	0.09	4.93
Oxygen	8	18445	12.46	19.50	45.35	1.64	13.15
Magnesium	12	1876	0.60	0.94	1.43	0.06	10.70
Aluminium	13	20386	5.19	8.12	11.20	0.28	5.37
Silicon	14	38502	7.06	11.04	14.64	0.33	4.67
Phosphorus	15	33542	7.01	10.97	13.19	0.30	4.30
Potassium	19	4612	0.85	1.33	1.27	0.05	6.44
Calcium	20	2315	0.49	0.77	0.71	0.04	8.89
Lanthanum	57	19072	7.24	11.32	3.03	0.23	3.18
Cerium	58	36846	14.61	22.86	6.07	0.43	2.93
Neodymium	60	14970	6.54	10.22	2.64	0.21	3.21
		Sum	63.93	100.00	100.00		

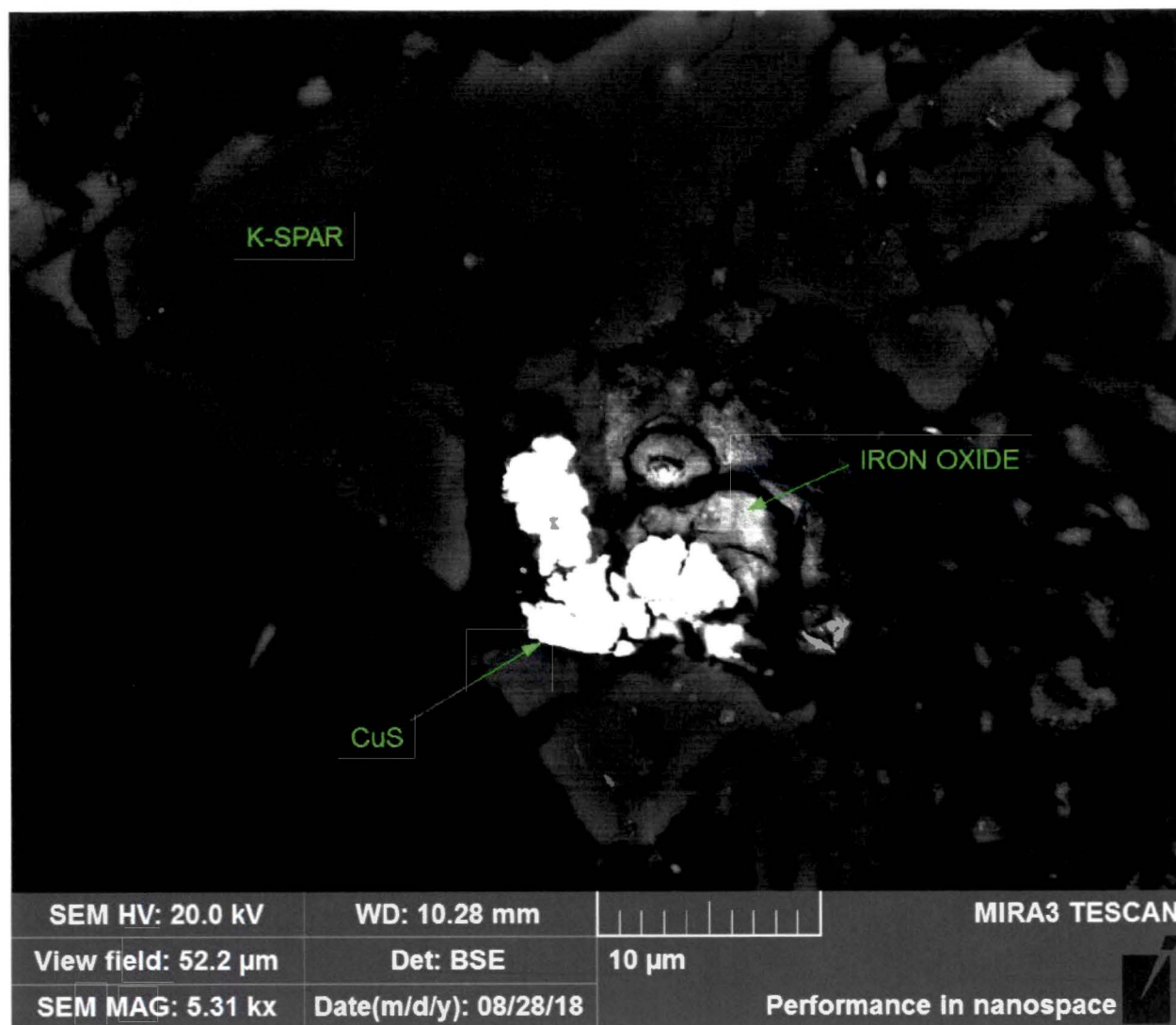


Client Sample No.: **WME-5**

Low magnification backscatter image showing the sample's fine-grained texture – 99X

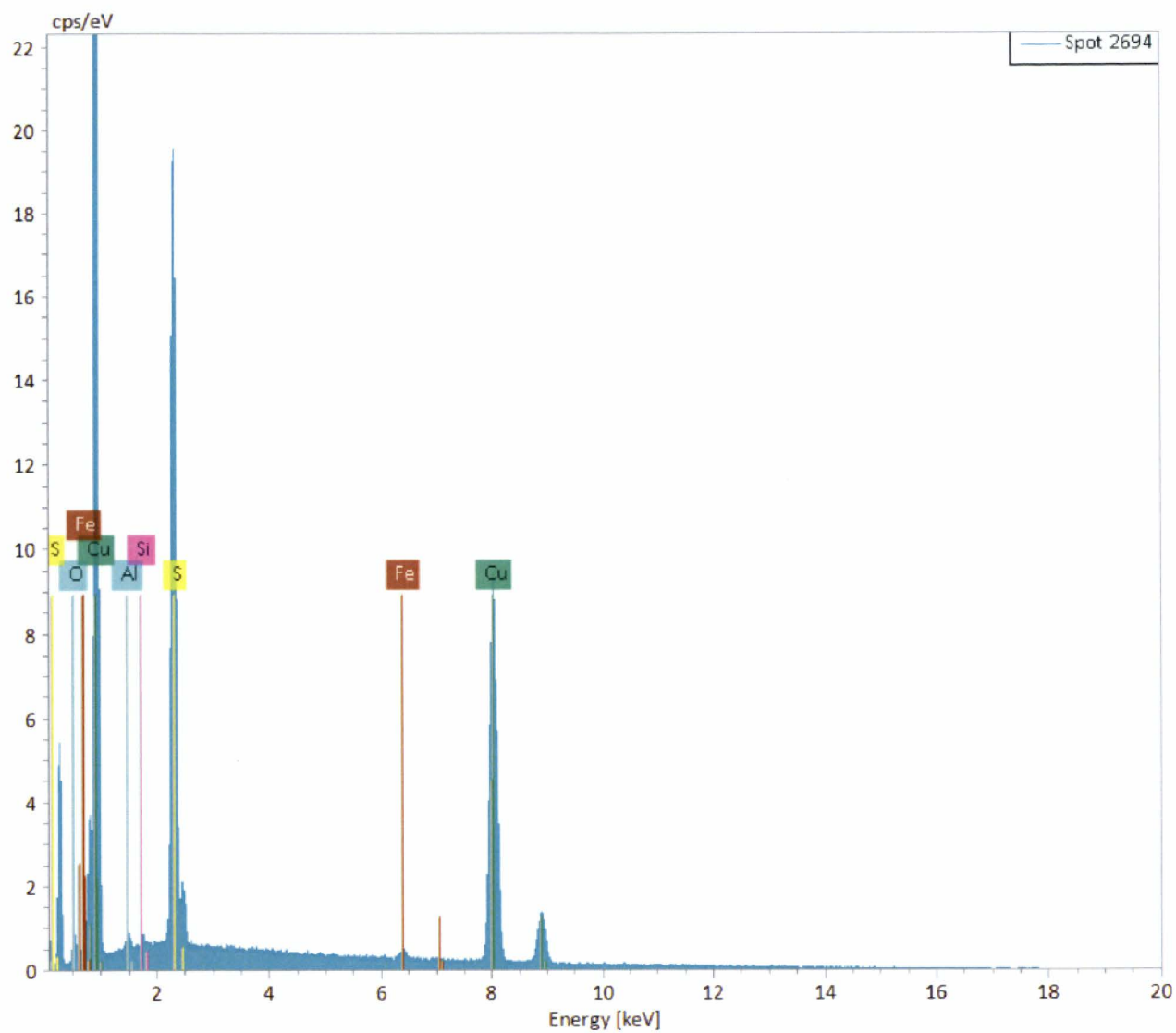
Client Sample No.: **WME-10**

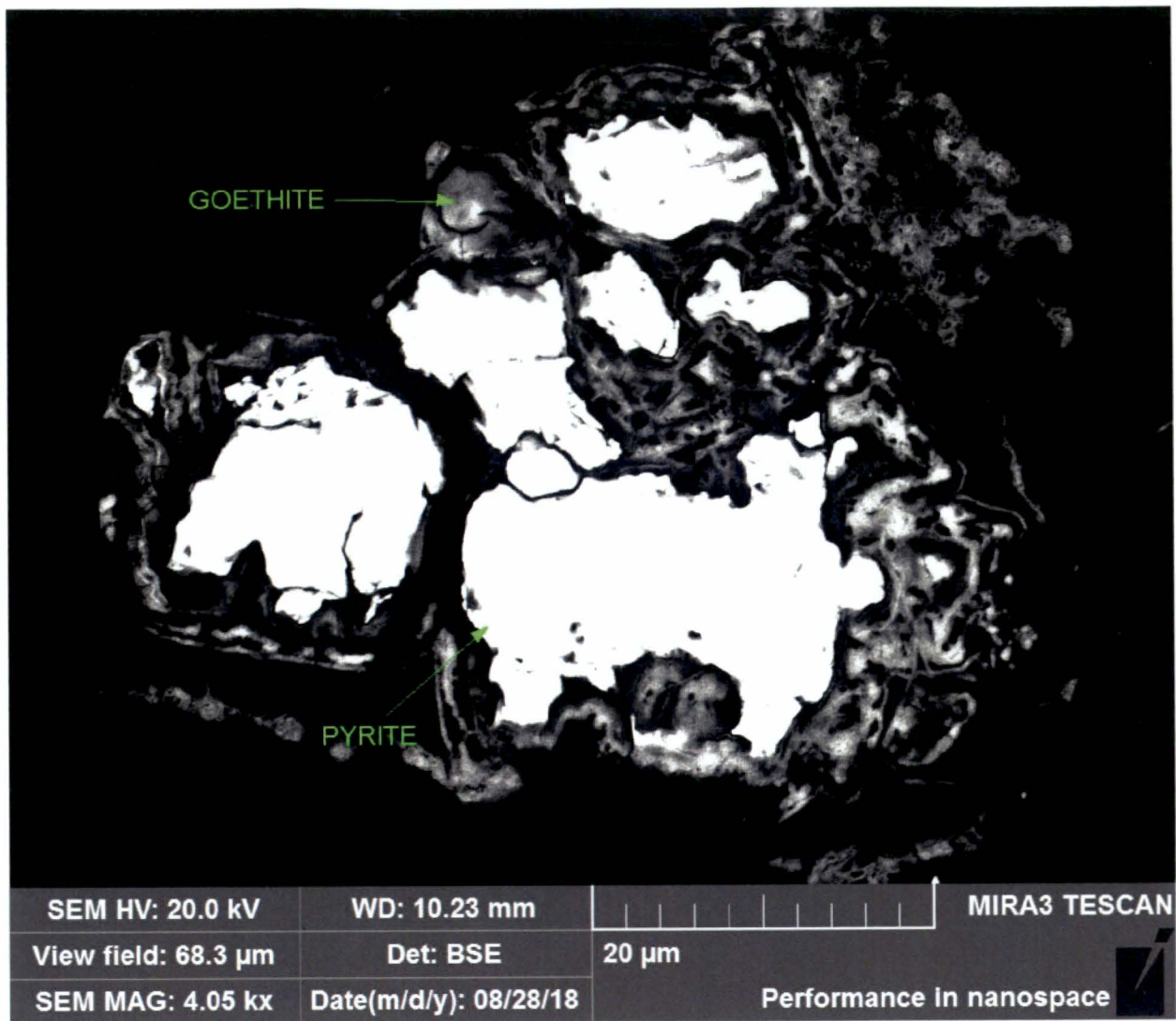
This sample is a brown colored fine to medium sand with moderate amounts of clay. XRD identifies the clay as primarily swelling smectite (~4%), kaolinite (~3%), chlorite (~2%) and illite (~1%). Numerous concentrated clay masses were analyzed by EDS but failed to detect any U content. Quartz (~53%) is the dominant hard silicate and occurs as angular to well rounded grains that vary greatly in size from 5 μ m to 350 μ m. K-spar and plagioclase are present in like concentrations of ~14% each and occur as angular to sub-angular fragments in the 5 μ m to 200 μ m size range. Plagioclase grains show mild grain boundary corrosion and intragrain pitting. The feldspars tend to carry small inclusions of barite, zircon, rare earth phosphates and sulfides. Pyrite and chalcopyrite are present as a trace with a grain size up to 20 μ m. Much of the pyrite shows replacement by goethite and chalcopyrite shows some replacement by Cu oxide, CuS (covellite?) and iron oxide. Calcite (~9%) occurs as small angular grains that vary significantly in size from 2 μ m up to 200 μ m. One large carbonate grain carries a small 4 μ m grain of Au. Selenides are present as a trace and represented by native Se, Pb-Se and Cu-Se. The grains are liberated with grain size measurements of 2 μ m to 3.5 μ m. Three grains composed of U, Ti and Fe were identified. They occur as irregularly shaped grains that vary in size from 0.4 μ m up to approximately 3 μ m and are attached to spongy looking iron oxide.



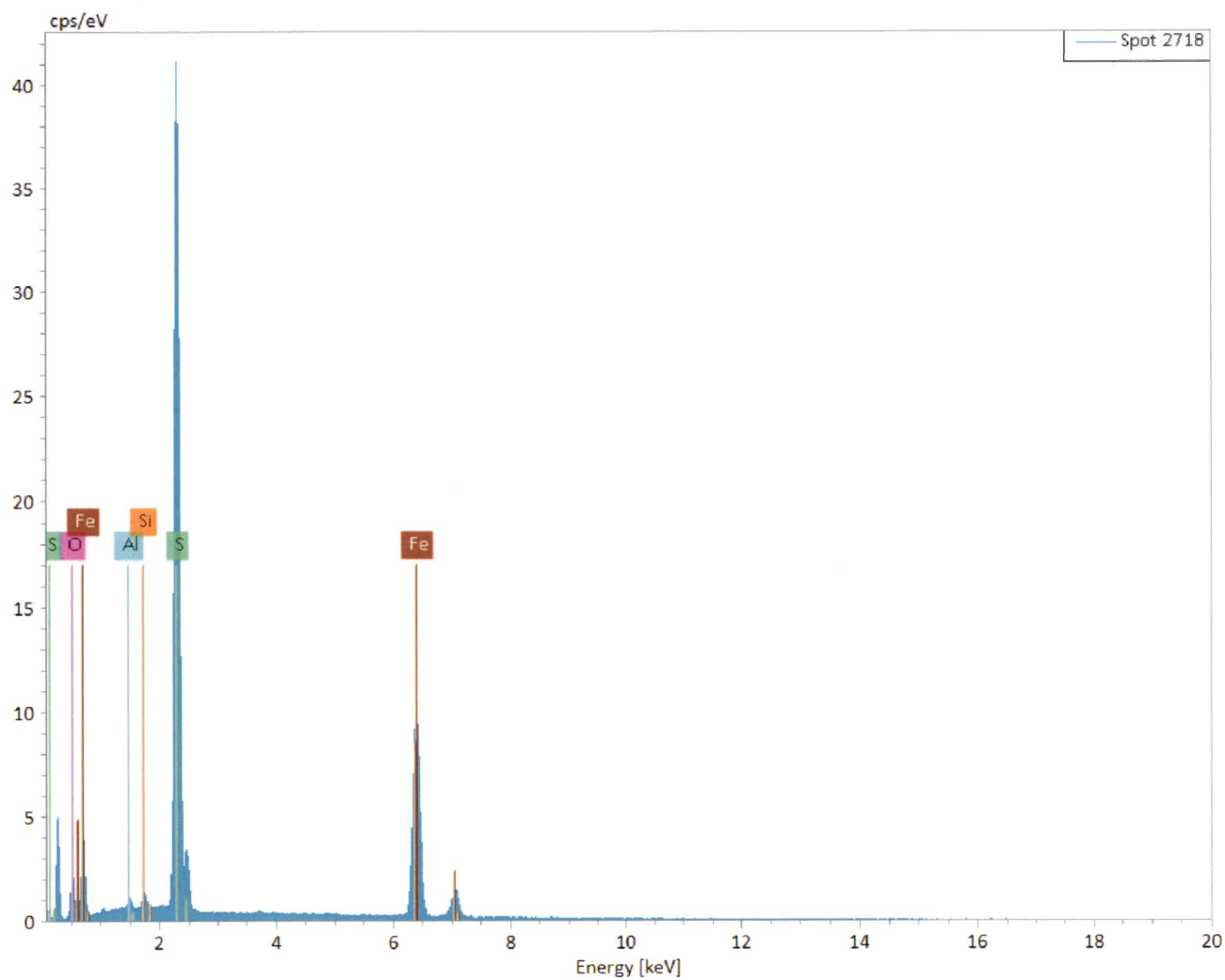
Client Sample No.: **WME-10**

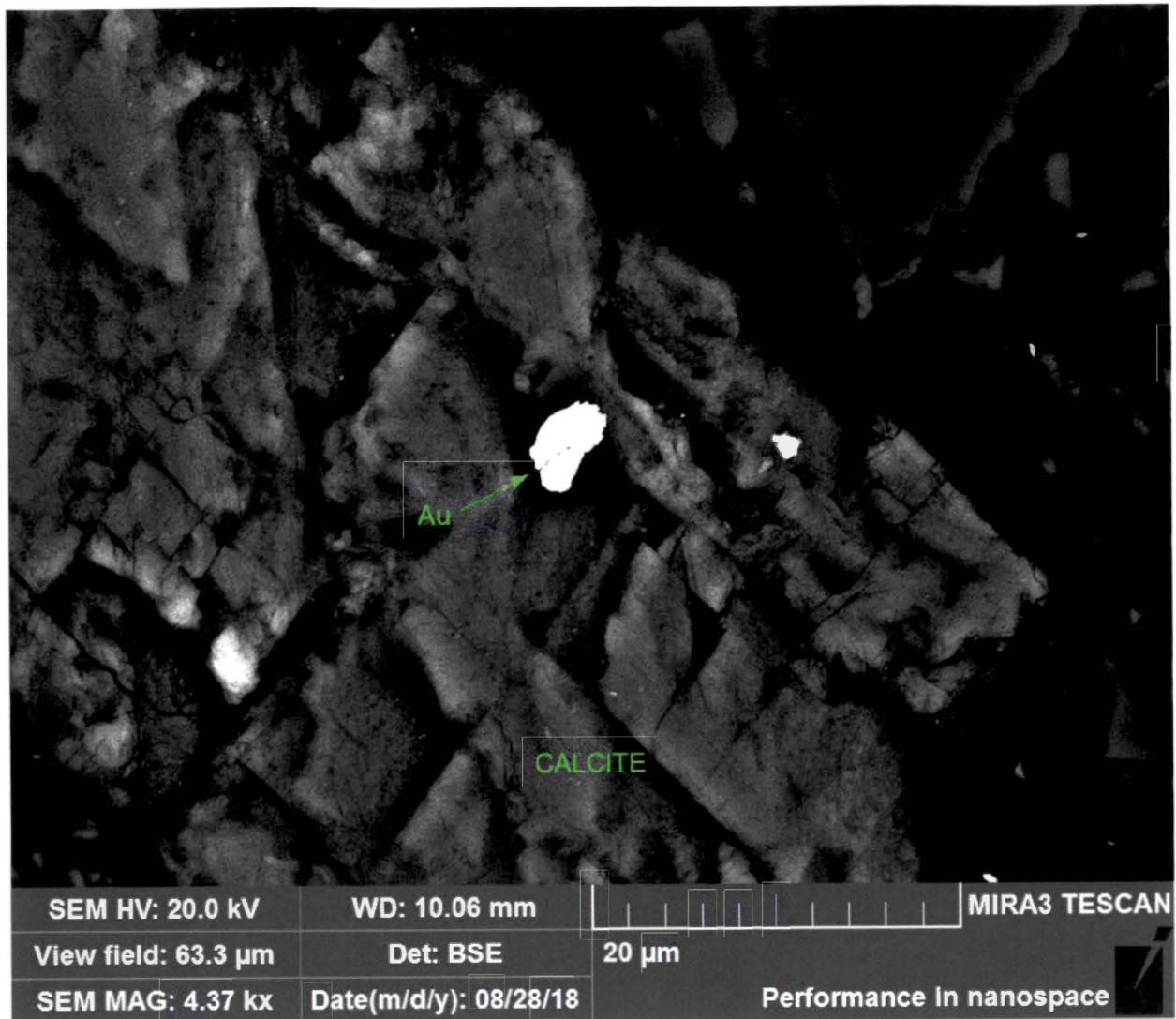
Backscatter image of covellite replacing chalcopyrite in a grain of K-spar – 5,310X



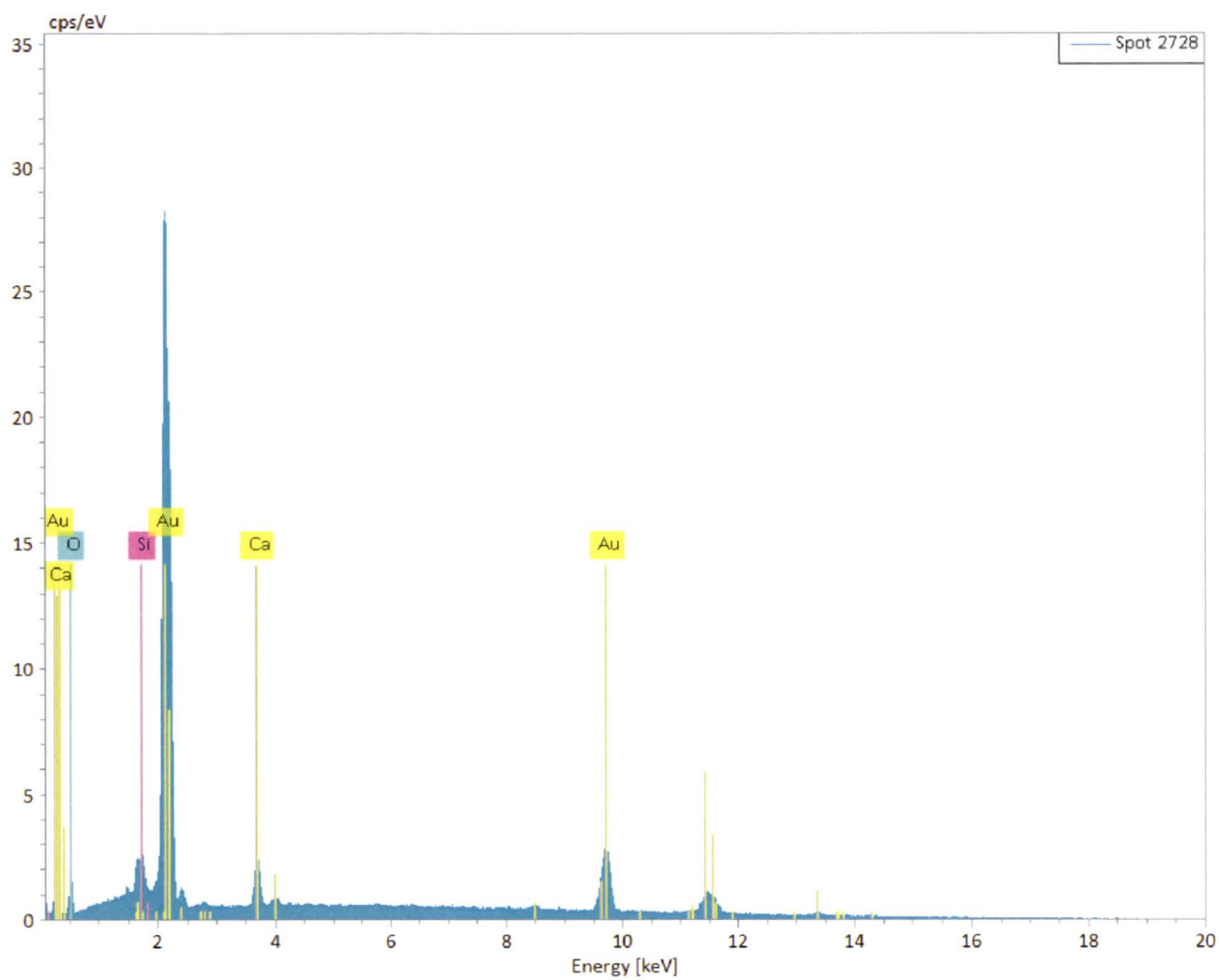


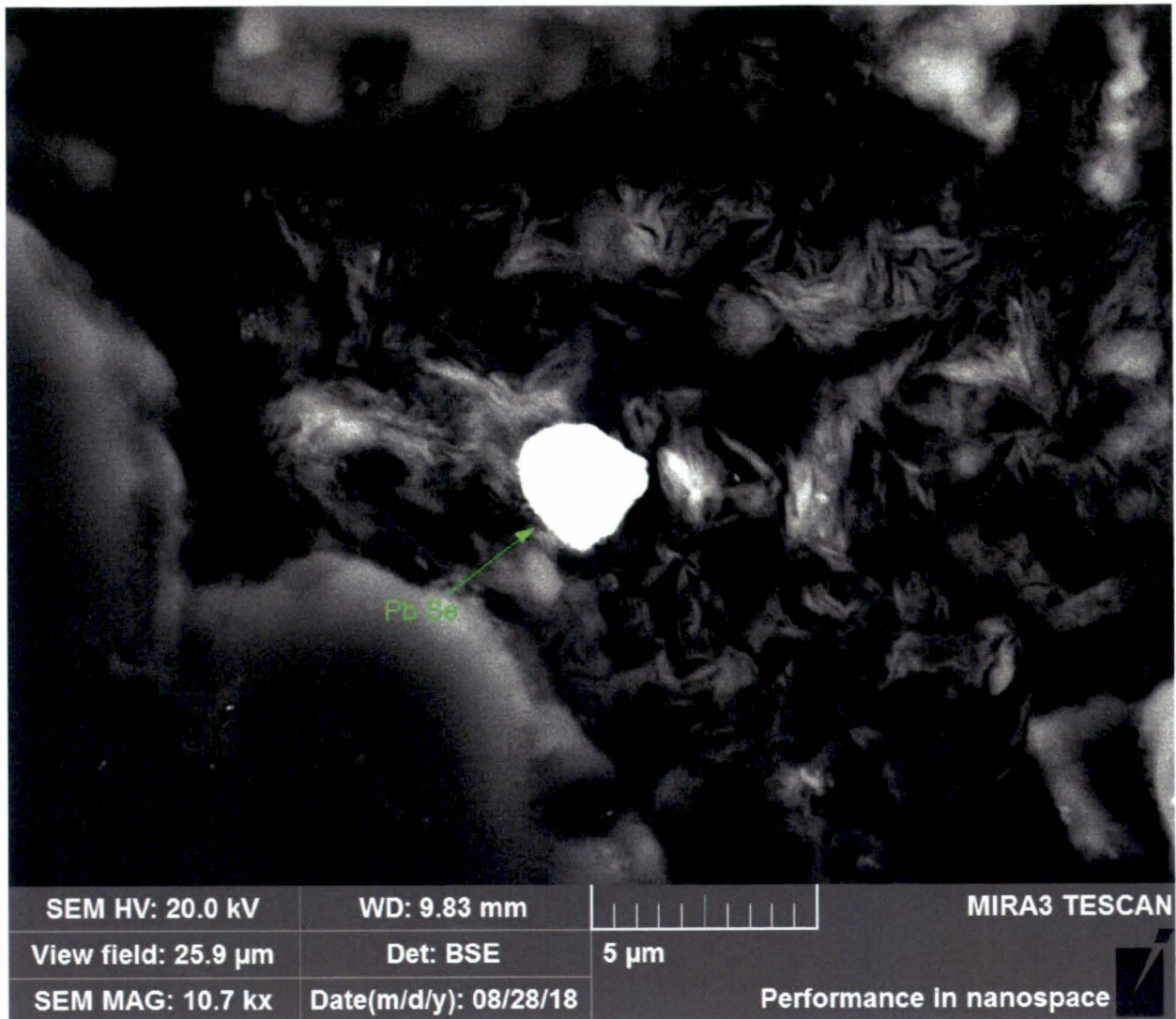
Client Sample No.: **WME-10**
Backscatter image of goethite replacing pyrite – 4,050X





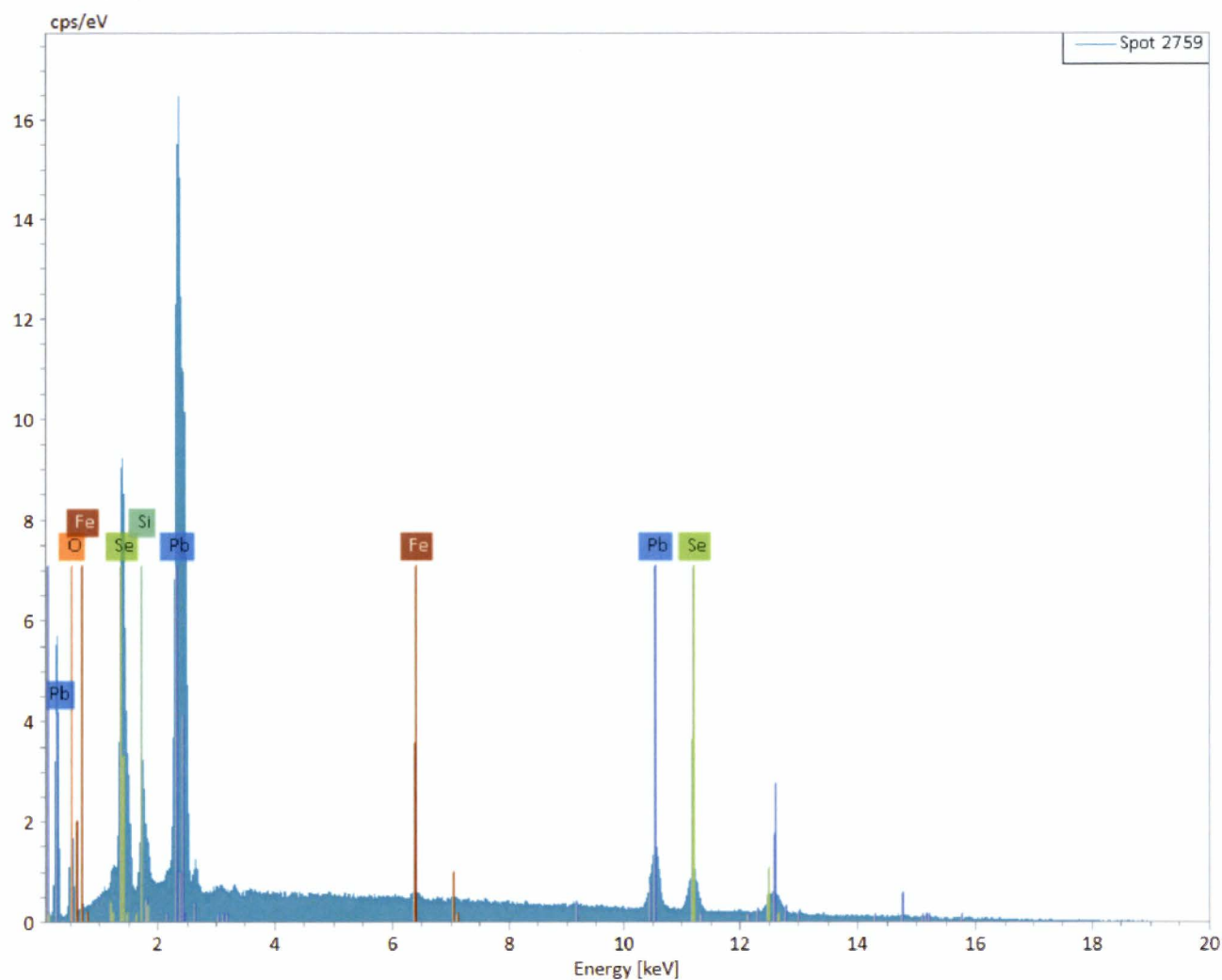
Client Sample No.: **WME-10**
Backscatter image of calcite with a bright grain of Au – 4,370X



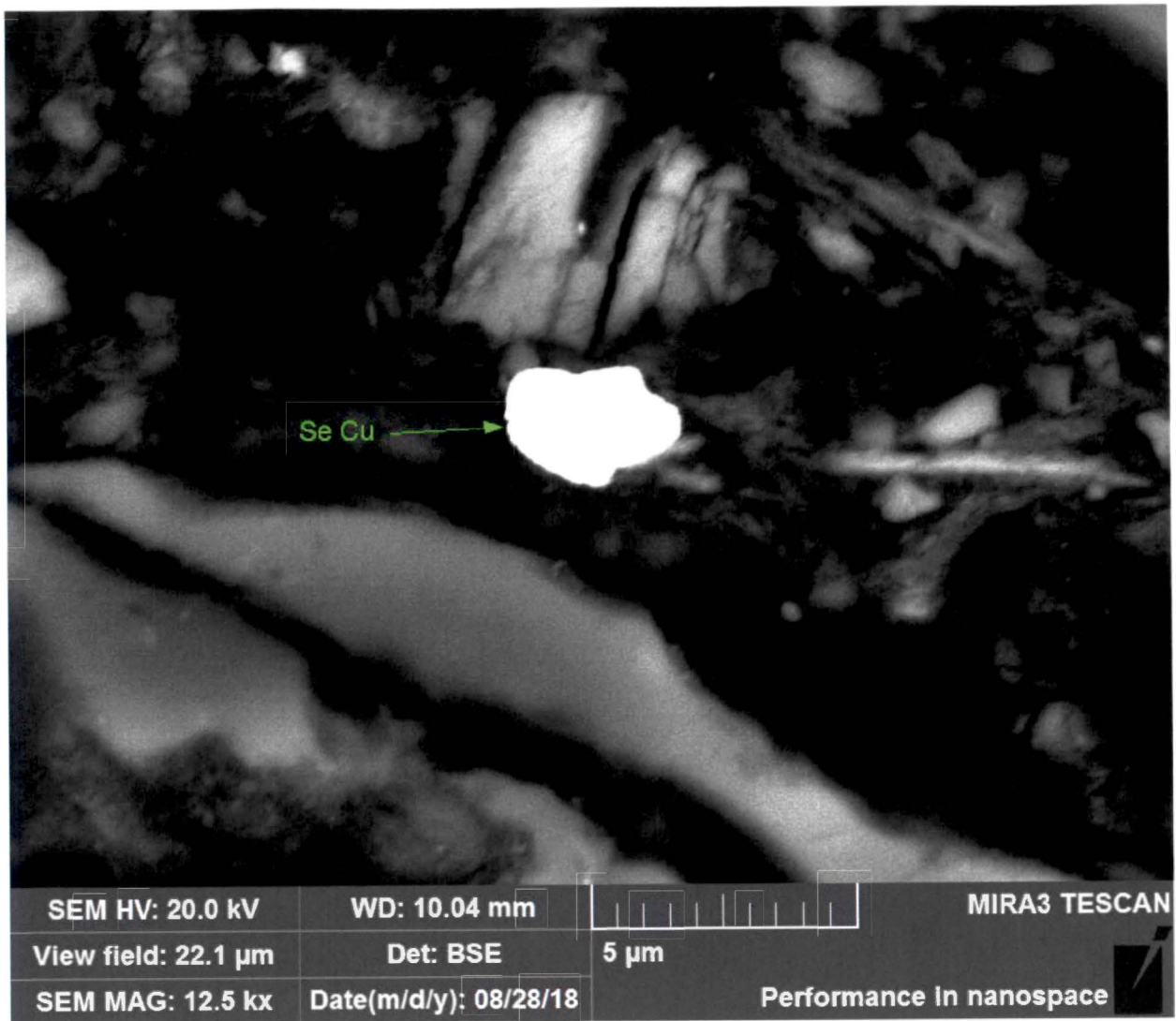


Client Sample No.: **WME-10**

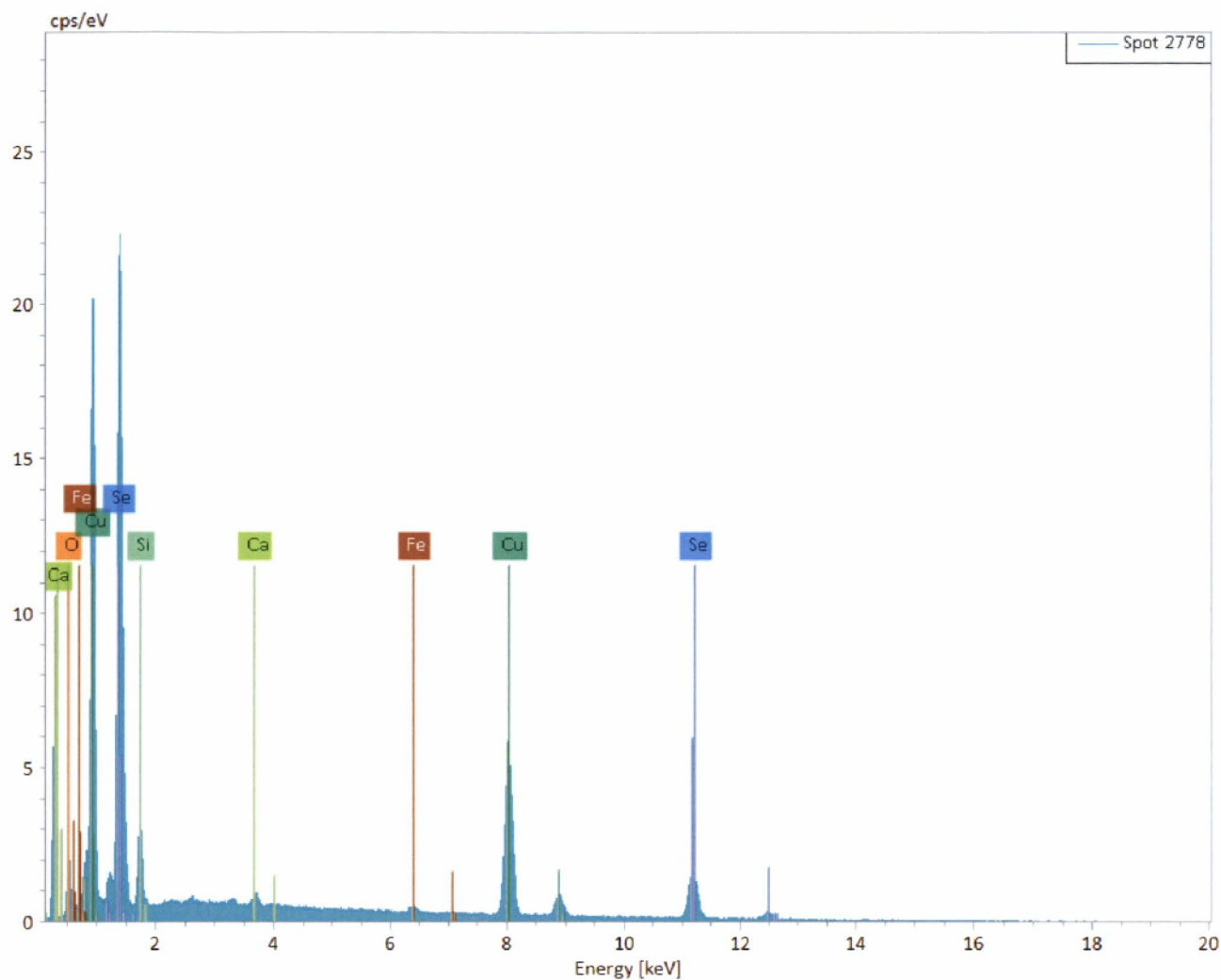
Backscatter image showing a bright grain of Pb selenide in clay -10,700X



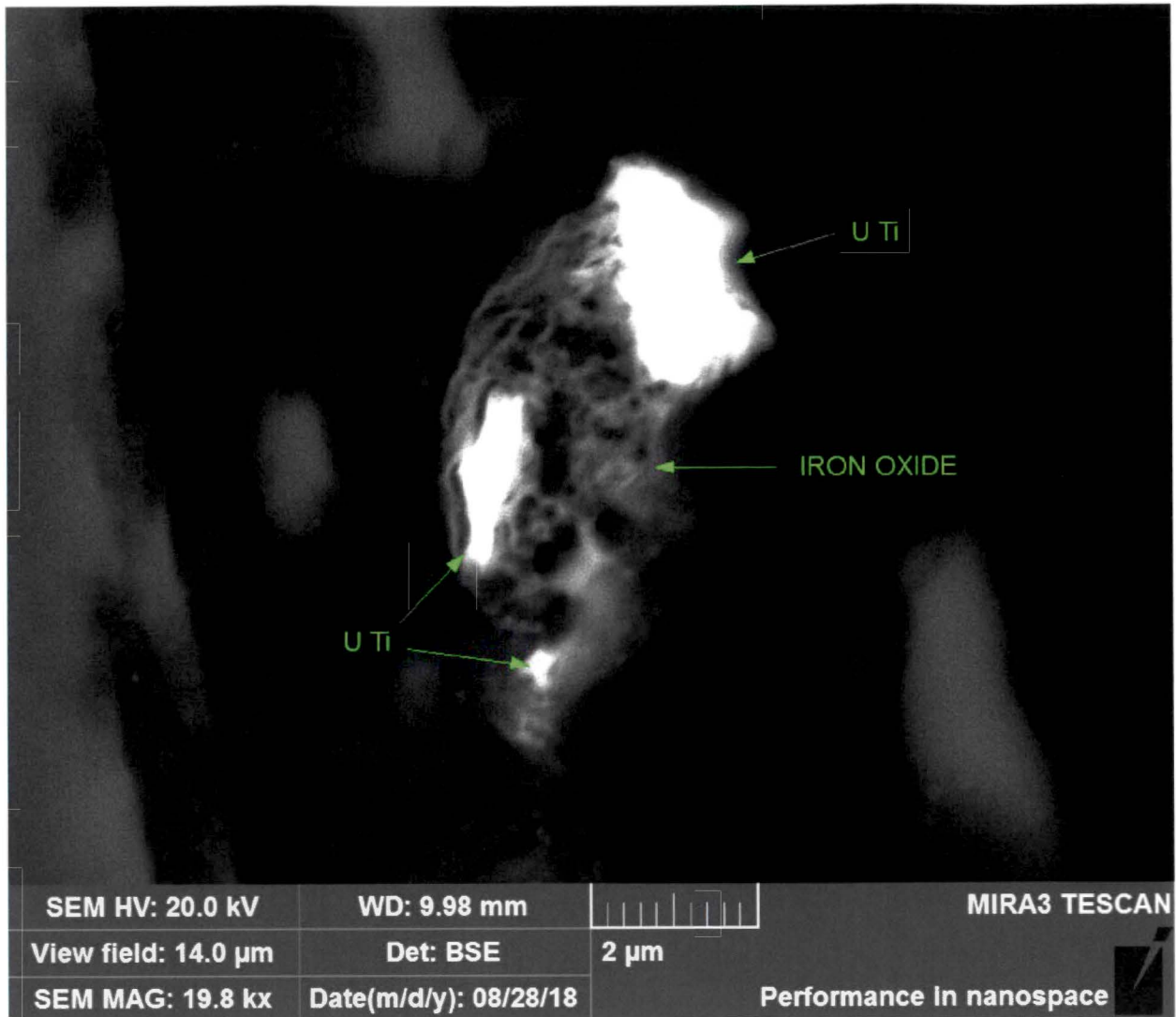
Element	At. No.	Netto	Mass [%]	Mass Norm. [%]	Atom [%]	abs. error [%] (1 sigma)	rel. error [%] (1 sigma)
Oxygen	8	1541	1.68	3.14	22.80	0.36	21.68
Silicon	14	0	0.00	0.00	0.00	0.00	2.25
Iron	26	776	0.44	0.82	1.71	0.05	10.45
Selenium	34	7829	12.70	23.70	34.90	0.43	3.42
Lead	82	15845	38.77	72.34	40.59	1.24	3.19
		Sum	53.59	100.00	100.00		



Client Sample No.: **WME-10**
Backscatter image of a Cu selenide in clay – 15,500X

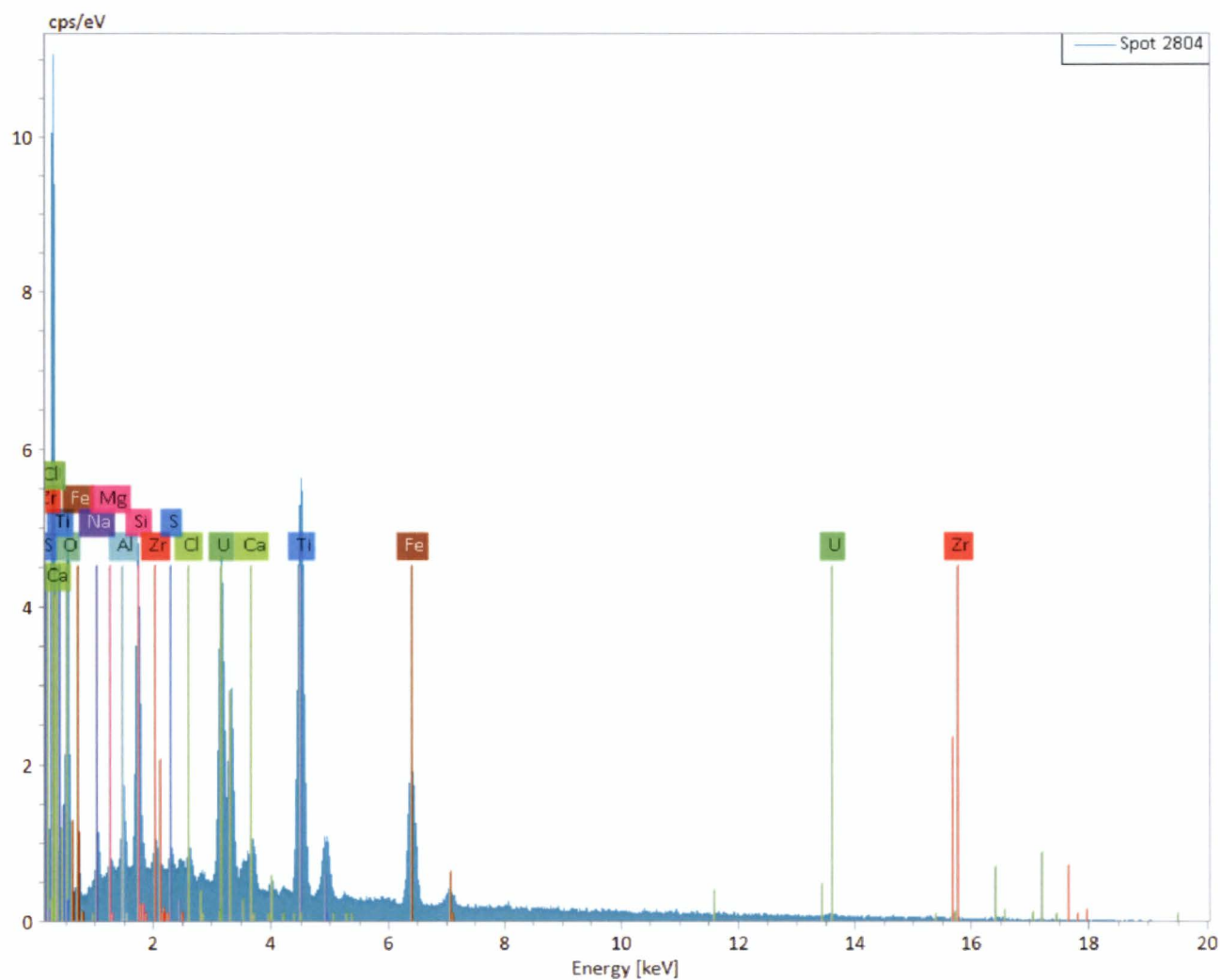


Element	At. No.	Netto	Mass [%]	Mass Norm. [%]	Atom [%]	abs. error [%] (1 sigma)	rel. error [%] (1 sigma)
Oxygen	8	5256	2.73	7.00	22.70	0.45	16.43
Silicon	14	12022	3.44	8.82	16.30	0.18	5.18
Calcium	20	2088	0.56	1.42	1.84	0.05	8.37
Copper	29	42933	9.87	25.30	20.66	0.29	2.98
Selenium	34	14435	21.36	54.72	35.96	0.69	3.21
Iron	26	3748	1.07	2.74	2.54	0.06	5.57
		Sum	39.03	100.00	100.00		

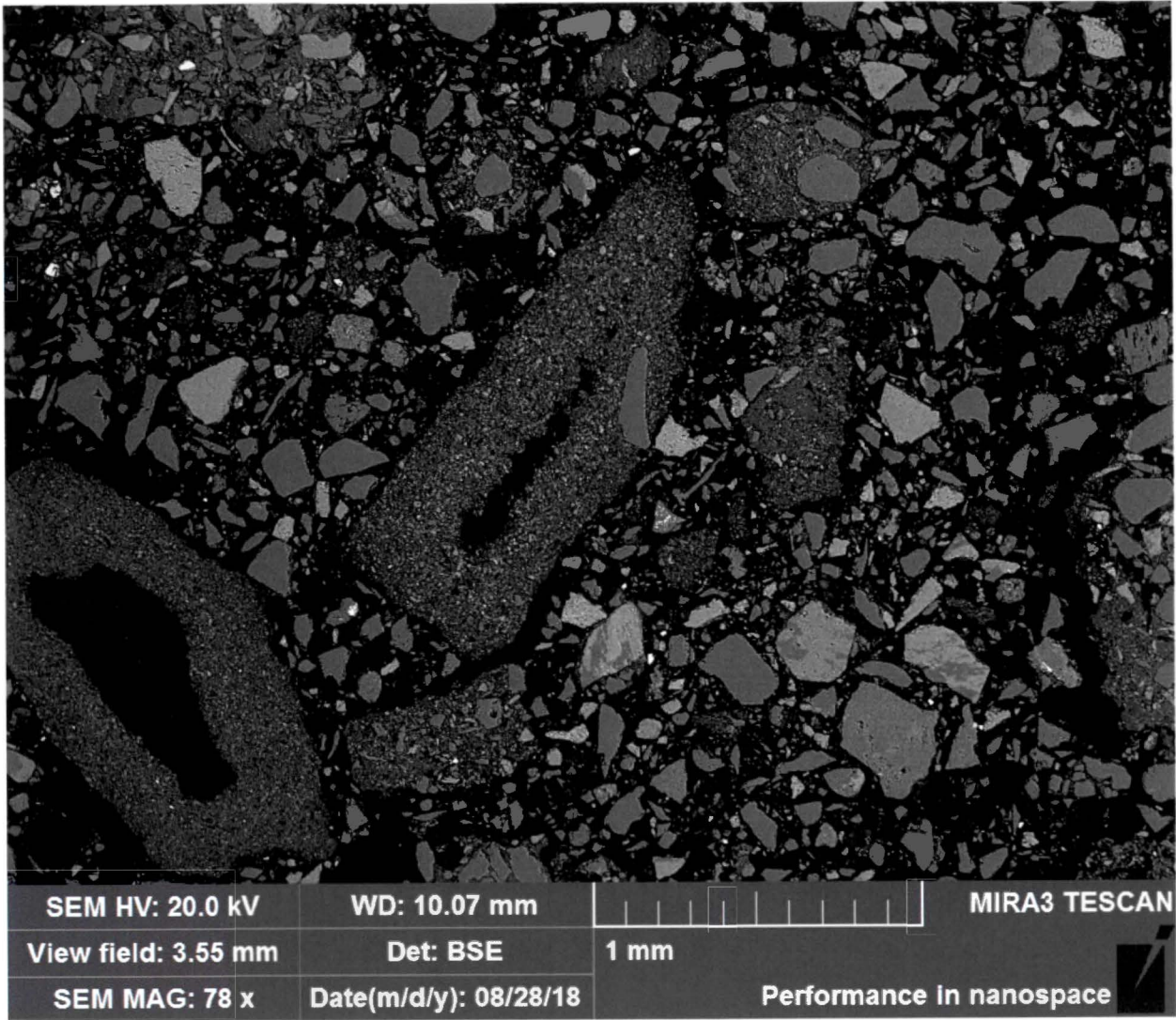


Client Sample No.: **WME-10**

Backscatter image of spongy looking iron oxide with attachments of a U-Ti phase – 19,800X



Element	At. No.	Netto	Mass [%]	Mass Norm. [%]	Atom [%]	abs. error [%] (1 sigma)	rel. error [%] (1 sigma)
Oxygen	8	13910	19.77	28.48	60.34	2.67	13.52
Aluminium	13	3798	1.05	1.52	1.91	0.08	7.72
Silicon	14	16097	3.02	4.35	5.25	0.16	5.23
Calcium	20	3847	1.20	1.73	1.46	0.07	5.56
Titanium	22	33869	15.02	21.64	15.32	0.45	3.00
Iron	26	12831	8.84	12.74	7.73	0.28	3.11
Uranium	92	34485	18.02	25.96	3.70	0.59	3.25
Zirconium	40	1335	0.45	0.65	0.24	0.05	10.72
Sodium	11	2339	1.39	2.00	2.94	0.13	9.11
Magnesium	12	812	0.31	0.44	0.62	0.05	15.66
Chlorine	17	1070	0.22	0.32	0.31	0.04	16.25
Sulfur	16	628	0.12	0.18	0.19	0.03	26.51
		Sum	69.43	100.00	100.00		

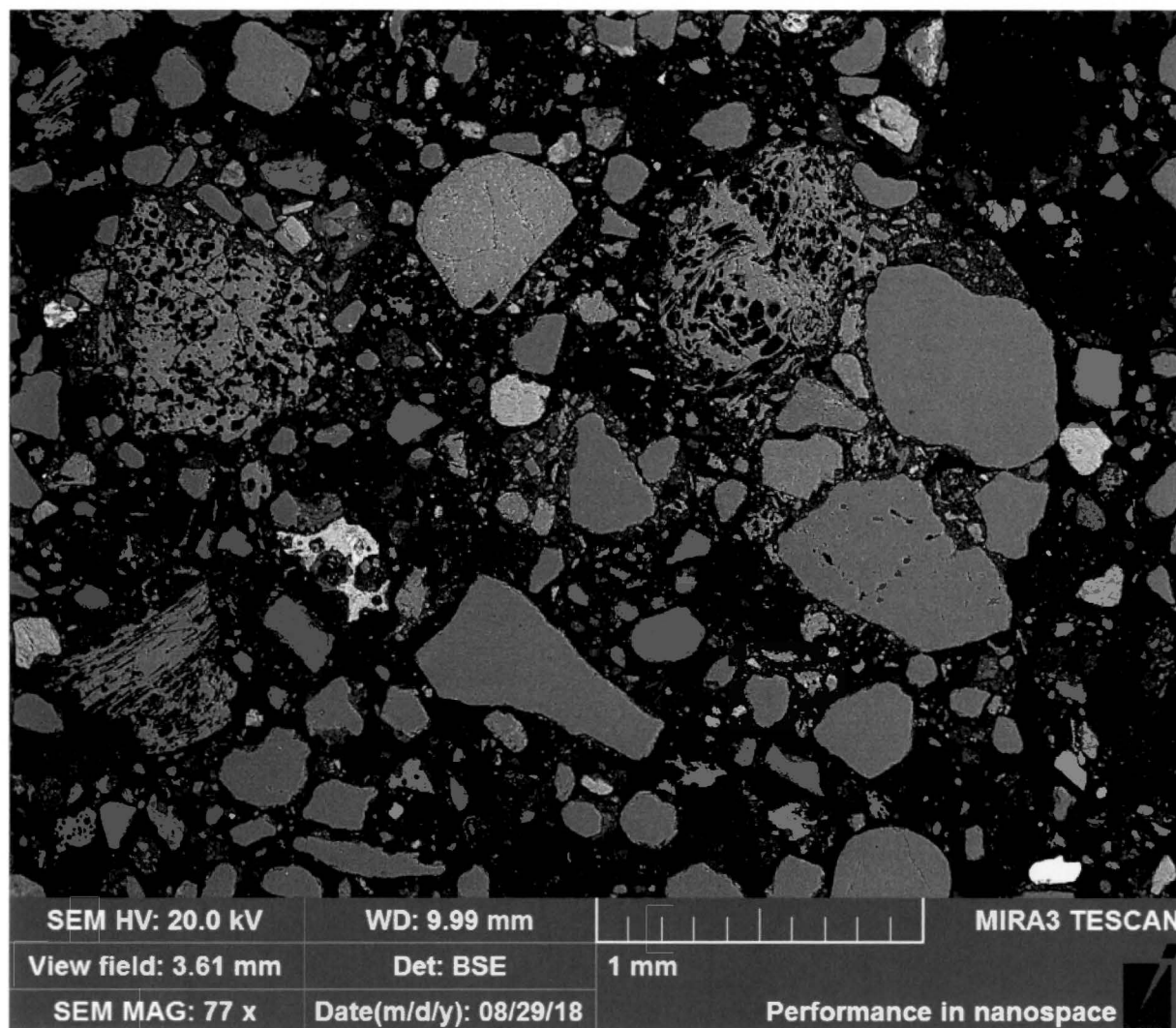


Client Sample No.: **WME-10**

Low magnification backscatter image showing the sample's variable texture – 78X

Client Sample No.: **WME-14**

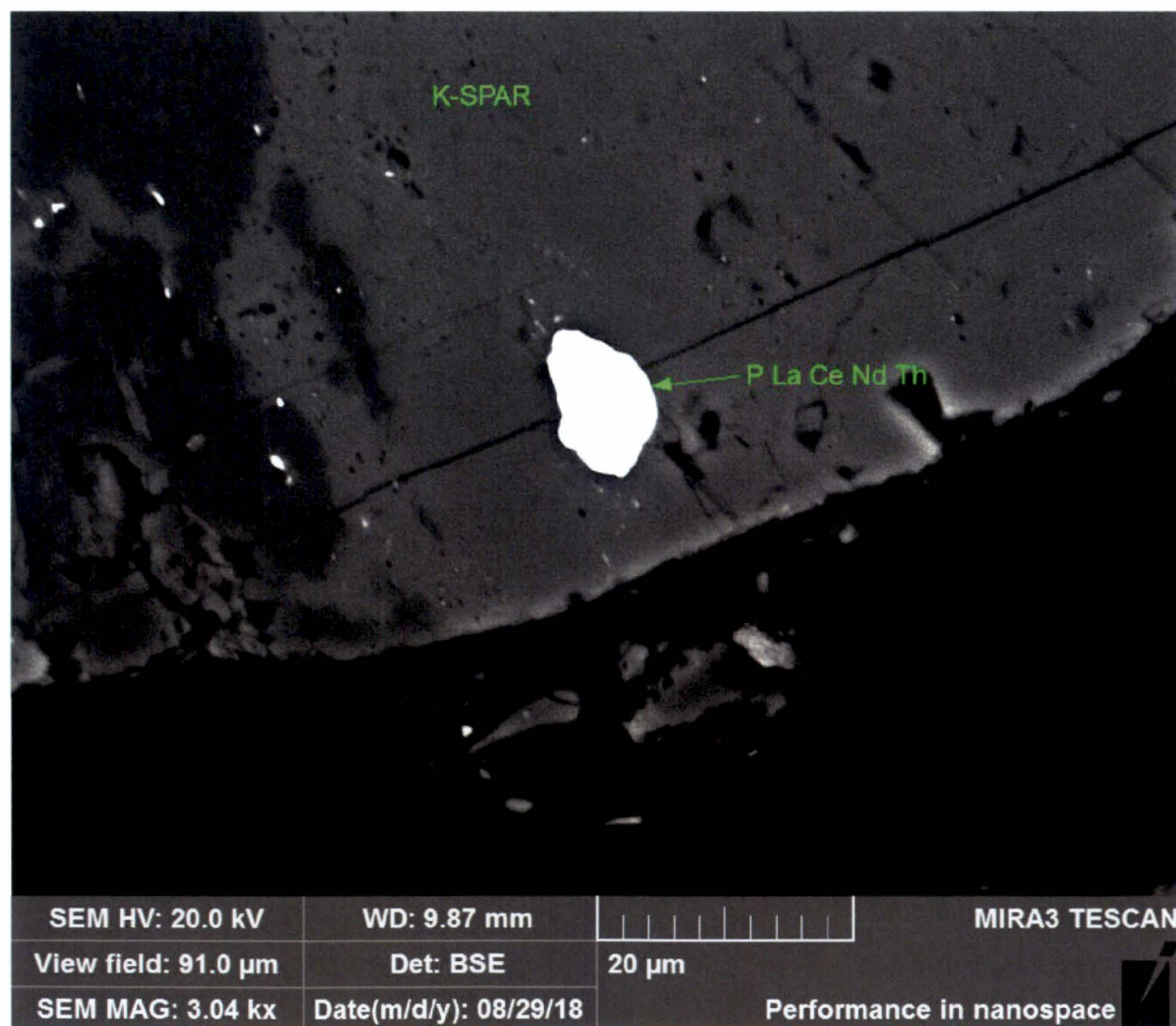
This material is a brown colored, coarse, gravelly sand with appreciable clay content. Collectively clay mineralogy accounts for ~15% of the sample's mass and is primarily mica/illite (~6%), kaolinite (~5%) and swelling smectite (~4%). Quartz (~40%) is the dominant silicate and occurs as angular to well-rounded grains that vary in size from 2 μ m up to 1mm. Plagioclase and K-spar collectively account for ~11% of the sample and occur as liberated angular fragments up to 1mm in size. Several basaltic rock fragments carry thin, euhedral, lath shaped grains of plagioclase. This sample also contains a significant amount of volcanic glass (~13%) that occurs as large vesicular fragments >1mm in size. These fragments commonly carry small euhedral grains of magnetite, titaniferous magnetite and ilmenite. Of the samples studied, this sediment has the highest concentration of calcite. Although the carbonate is generally very fine grained with measurements that vary from 2 μ m to 150 μ m, a few large fine-grained aggregates measure several millimeters in size. Accessory minerals include a trace of pyrite, chalcopyrite, barite, xenotime, rutile and zircon. An extensive search fail to identify U containing phases.

Client Sample No.: **WME-14**

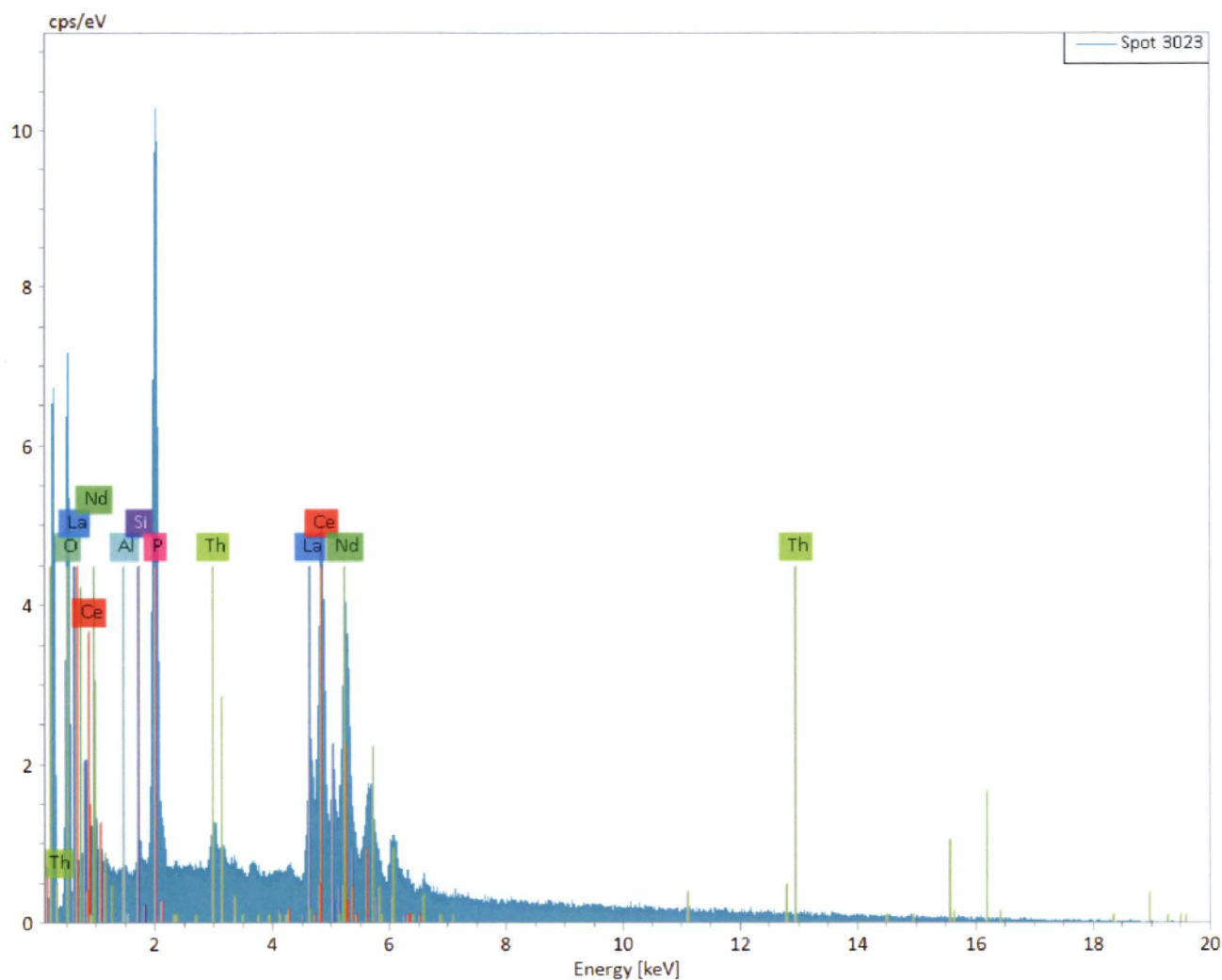
Low magnification backscatter image showing grain texture – 77X

Client Sample No.: **WME-16**

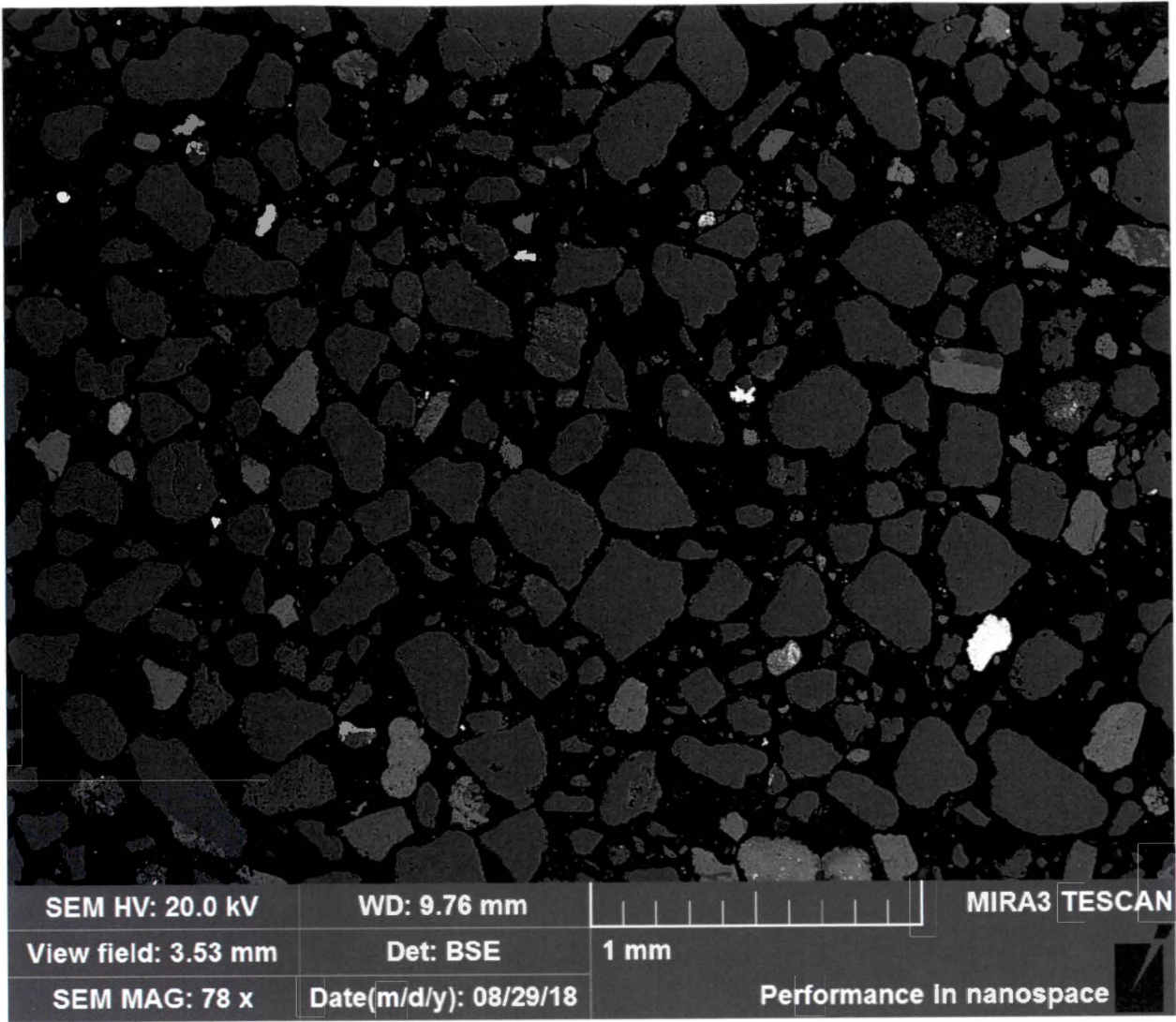
In thin section, this sample contains simple mineralogy. The sediment is a fine to medium grained sand with low clay content. Total clay content is ~2% with kaolinite (~1%) and swelling smectite (~1%) as the primary types and trace amounts of illite/chlorite. Like previous samples, quartz (~77%) is the main hard silicate and occurs as angular to well rounded grains with measurements that vary from 5 μ m up to 350 μ m. Plagioclase (~7%) and K-spar (~8%) occur as angular to sub-rounded grains that vary from 5 μ m up to 250 μ m. The feldspar commonly carries small inclusions of barite, rutile, zircon, rare earth phosphates and pyrite. Calcite (~6%) is the sole carbonate and occurs as angular fragments with a size variation of 5 μ m to 150 μ m. Although an extensive search failed to detect U bearing phases, a monazite grain included in K-spar contains some Th content.

Client Sample No.: **WME-16**

Backscatter image of K-spar with numerous bright grains of monazite with Th – 3,040X



Element	At. No.	Netto	Mass [%]	Mass Norm. [%]	Atom [%]	abs. error [%] (1 sigma)	rel. error [%] (1 sigma)
Oxygen	8	12372	14.39	19.13	55.05	1.98	13.77
Aluminium	13	393	0.24	0.32	0.54	0.04	18.66
Silicon	14	788	0.31	0.42	0.68	0.04	14.34
Phosphorus	15	28554	11.61	15.44	22.94	0.48	4.17
Lanthanum	57	13988	10.29	13.68	4.53	0.32	3.12
Cerium	58	33471	25.57	34.00	11.17	0.73	2.86
Neodymium	60	12974	10.67	14.19	4.53	0.33	3.09
Thorium	90	2626	2.12	2.82	0.56	0.11	5.09
		Sum	75.22	100.00	100.00		



Client Sample No.: **WME-16**
Low magnification backscatter image showing grain texture – 78X



Laboratories, Inc.

2773 Downhill Drive Steamboat Springs, CO 80487 (800) 334-5493

CHAIN of CUSTODY

Report to:

Name: Scott Habermehl

Company: ACZ Labs

E-mail: scotth@acz.com

Address: 2773 Downhill Dr.

Telephone: (970)879-6590 x101

Copy of Report to:

Name:

Company:

E-mail:

Telephone:

Invoice to:

Name: Jason Calo

Company: ACZ Labs

E-mail: jcalo@acz.com

Address:

Telephone:

If sample(s) received past holding time (HT), or if insufficient HT remains to complete analysis before expiration, shall ACZ proceed with requested short HT analyses?

YES ☒
NO ☐

If "NO" then ACZ will contact client for further instruction. If neither "YES" nor "NO" is indicated, ACZ will proceed with the requested analyses, even if HT is expired, and data will be qualified.

Are samples for SDWA Compliance Monitoring?

Yes ☐

No ☒

If yes, please include state forms. Results will be reported to PQL for Colorado.

Sampler's Name: _____ Sampler's Site Information State CO Zip code _____ Time Zone _____

*Sampler's Signature: _____

*I attest to the authenticity and validity of this sample. I understand that intentionally mislabeling the time/date/location or tampering with the sample in anyway, is considered fraud and punishable by State Law.

PROJECT INFORMATION

ANALYSES REQUESTED (attach list or use quote number)

Quote #:

PO#:

Reporting state for compliance testing:

Check box if samples include NRC licensed material? ☐

SAMPLE IDENTIFICATION	DATE:TIME	Matrix	# of Containers	XRD - Bulk & Clay	SEM								
WME-8@110	6/14/18	SO	1	☒	☐	☐	☐	☐	☐	☐	☐	☐	☐
WME-8@121	6/18/18	SO	1	☒	☐	☐	☐	☐	☐	☐	☐	☐	☐
WME-11	6/15/18	SO	1	☒	☐	☐	☐	☐	☐	☐	☐	☐	☐
WME-14	6/17/18	SO	1	☒	☒	☐	☐	☐	☐	☐	☐	☐	☐
WME-15	6/18/18	SO	1	☒	☐	☐	☐	☐	☐	☐	☐	☐	☐
WME-16	6/19/18	SO	1	☒	☒	☐	☐	☐	☐	☐	☐	☐	☐
WME-17	6/19/19	SO	1	☒	☐	☐	☐	☐	☐	☐	☐	☐	☐
				☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
				☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
				☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

Matrix SW (Surface Water) · GW (Ground Water) · WW (Waste Water) · DW (Drinking Water) · SL (Sludge) · SO (Soil) · OL (Oil) · Other (Specify)

REMARKS

DCM Science, 12421 W. 49th St. Unit 6, Wheat Ridge CO 80033

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1. INTRODUCTION

Homestake Mining Company of California (HMC) is proposing to update the groundwater monitoring plan in its NRC license (SUA-1471) to adjust the compliance monitoring for the groundwater restoration areas at the Grants Reclamation Project site. The reason for this is to take in account changes in the restoration program and problematic wells where access is restricted by current property owners. This report includes a listing and location of the proposed wells to be used for continued compliance groundwater monitoring at HMC's Grants Reclamation Project. The monitoring wells will be used to demonstrate groundwater restoration at the Grants site relative to the site standards. Appendix A contains a table and figure summarizing the existing Grants groundwater monitoring program. Tables 2-1 and 2-2 and Figures 2-1 through 2-5 in this report present the proposed groundwater monitoring wells and their locations that will be used for more accurate monitoring of site conditions. These wells have already been installed and are currently being sampled.

Three ground-water restoration areas have been defined for the Grants site. These areas are the On-Site restoration area and two Off-Site areas (South and North). Figure 1-1 shows the locations of the three ground-water restoration areas. Ground water collected from wells in the On-Site area will mainly be treated with the RO plant, while the collected water from the two Off-Site areas is treated through the zeolite process. The aquifer figures show the areas where ground-water restoration is needed in the alluvial, Upper Chinle, Middle Chinle and the Lower Chinle aquifers. Wells were selected for the groundwater compliance monitoring to cover the areas of the ground-water restoration in each aquifer.

1.1 On-Site

The On-Site restoration area includes the areas near the Large Tailings Pile (LTP) and Small Tailings Pile (STP) and an area west of the LTP out to the center of Section 27. It also includes the restoration of the alluvial aquifer to the south of the STP which is called the L area. Restoration in the On-Site area will be in the alluvial, Upper and Middle Chinle aquifers.

1.2 South Off-Site

The South Off-Site restoration area includes areas in Section 3, Section 34 irrigation area and Felice Acres and adjacent areas. Restoration in the South Off-Site area will be in the alluvial, Middle and Lower Chinle aquifers. A very minor amount of restoration is needed in the Upper Chinle aquifer in the South Off-Site area.

1.3 North Off-Site

The North Off-Site restoration area includes the western half of Section 27, Section 28 and an area to the south of this area which includes the Section 33 South Pivot. Restoration in the North Off-Site area is only in the alluvial aquifer.

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HOMESTAKE MINING COMPANY OF CALIFORNIA

Grants Reclamation Project



Groundwater Compliance Monitoring Plan Revisions

Submitted On:
December 2017

Submitted To:
Nuclear Regulatory Commission
New Mexico Environment Department

Submitted By:
Thomas Wohlford, Closure Manager, Grants
George Hoffman, Hydro-Engineering LLC

APPENDIX B

Second Interim Draft Geochemical Characterization of Tailings, Alluvial Solids, and Groundwater

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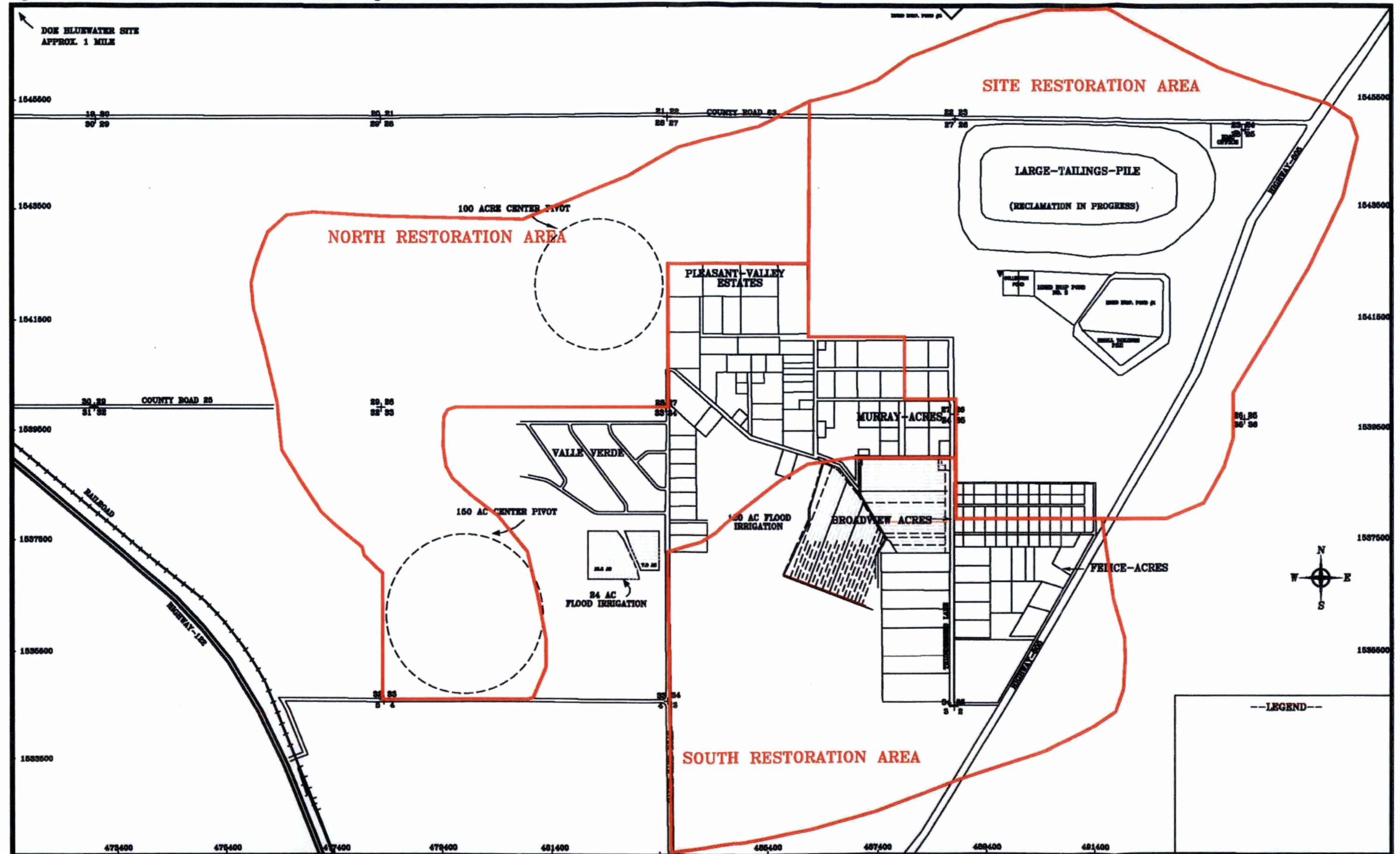
Attachment 5
LTP Static Column Testing Results

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Attachment 4

Humidity Cell Testing Results

Figure 1-1. Restoration Areas and the Location of Irrigation Areas



2. GROUNDWATER COMPLIANCE MONITORING

The revised groundwater compliance monitoring program will consist of selected monitoring wells in the restoration areas to demonstrate restoration efforts to meet the Grants groundwater site standards. These wells will be monitored annually for all of the Grants site standard constituents. A large amount of additional groundwater information will be collected and used annually to evaluate the groundwater restoration. Wells were selected to provide a distribution over the groundwater restoration areas for compliance monitoring to adequately define water quality in the restored aquifer. These wells are also expected to be used for the post-closure monitoring.

The existing groundwater monitoring wells are presented in Appendix A {Table 2 (8-99)} and their locations are also shown in the figure in Appendix A. Addition of wells for coverage of the compliance monitoring of the restoration areas and changes from wells that have been problematic in sampling have been made. Table 2-1 presents the list of wells to be monitored at the Grants site. This monitoring table initially list alluvial background wells, P, Q and 921 to be sampled annually for the B and F list of parameters. The constituents in each of these list are tabulated in Table 2-2 which also presents the laboratory method of analysis, detection limit and units for each parameter. Well Q is added for an additional background well for additional data beyond well P. Well 921 replaces well 920 as the far upgradient monitoring well. Well 921 was drilled by NMED and is a PVC cased well, on HMC land and is located in the center of the San Mateo alluvial channel. It therefore is considered to be a better monitoring well than well 920.

Operational monitoring is listed next in Table 2-1 followed by the San Andres monitoring which defines the water quality of the fresh water used at the Grants site. Figure 2-1 shows the locations of the four San Andres wells on the Grants site used for monitoring of the fresh water supply. San Andres wells 943M and 951R have been added to the San Andres monitoring due to the usage of these two wells for fresh water supply. The four pairs of reversal wells are listed in the operational monitoring. The KZ-KF pair has been replaced with the KZ-DZ reversal pair of wells while well S5 has replaced well S1 in the S2-S1 reversal pair. Reversal pair SM-SN have replaced SO-SP to better define the groundwater gradient reversal in this area. The operational monitoring also includes the monitoring of Post Treatment Tank (PTT) water prior to injection into the groundwater. The PTT water which includes a mixture of RO product water, zeolite treated water and fresh water from the San Andres aquifer is monitored quarterly for all site standards. Four of the site standards, nitrate, vanadium, Ra-226+228 and Th-230, should be less than their site standard concentration in the input water to the treatment systems and therefore are not measured in the monthly samples.

Compliance monitoring wells for the alluvial and Upper, Middle and Lower Chinle aquifers are listed in the remainder of Table 2-1.

2.1 Alluvial Aquifer

Wells in the On-Site, South Off-Site and North Off-Site areas will be used to restore the alluvial aquifer in these three areas. Figure 2-2 shows the locations of the alluvial wells to be used in the compliance monitoring of the alluvial aquifer. The green pattern on this figure shows where the alluvial aquifer exceeded the uranium site standard in 2016. The alluvial compliance monitoring wells, DD, DD2 and X, adjacent to the evaporation ponds are first listed in Table 2-1. Figure 2-2 shows the locations of these three wells while Table 2-3 gives the well data for these three wells and the remainder of the alluvial On-site wells. The additional On-site alluvial compliance monitoring wells are listed in an additional row on Table 2-1 while the locations of these wells are also shown on Figure 2-2. These alluvial compliance monitoring wells were selected for coverage of the On-site alluvial restoration area. Several On-site monitoring wells have been added to wells F, FB, GH and MO for better coverage of the alluvial On-site compliance monitoring of this restoration area.

The South Off-site area alluvial compliance monitoring wells are listed in two categories, Section 34 land application and South Off-site, in Table 2-1. Table 2-4 presents the completion information for the Off-site alluvial monitoring wells. The Section 34 land application wells were selected within the irrigation area and for coverage downgradient of the land application area. These Section 34 wells are the same as those required in the New Mexico Environment Department (NMED, 2014) DP200 permit and are used to monitor the groundwater in the Section 34 flood area and downgradient of this irrigation. The remainder of the South Off-site area were selected to define the restoration of the alluvial South Off-site area. Several additional wells have been added to the 490 and SUB 2 monitoring of the South Off-site area to have adequate coverage of the South Off-site alluvial groundwater restoration area. Wells 492 and SUB1 which have been sampled only a few times in the last decade because lack of access have been dropped from the South Off-site monitoring. Wells 490, SUB2 and 844 adequately cover this area of the South Off-site alluvial aquifer.

The remaining two rows of the alluvial compliance monitoring are in the North Off-site area and listed as the North Off-site area and western portion of the North Off-site area. Compliance wells in the western portion of the North Off-site area are the same as those proposed for post-closure monitoring in this area because alluvial groundwater quality has been restored in the western portion of the North Off-site area. Table 2-1 lists the proposed monitoring wells in the western portion of the North Off-site area which include the Section 33 former land application area. Table 2-4 also presents the completion information for the North Off-site alluvial compliance monitoring wells. The North Off-site alluvial compliance monitoring wells were selected to cover the North Off-site restoration area and are listed in Table 2-1. This list includes the Section 28 land application wells required in NMED DP200 permit. The North Off-site compliance monitoring wells have been added for compliance monitoring of the North Off-site restoration area. Well 942 which has not been accessible to be sampled the last several years is being replaced with well 883.

2.2 Upper Chinle Aquifer

Compliance monitoring is needed in the On-Site and South Off-Site areas for the Upper Chinle aquifer. Figure 2-3 shows the Upper Chinle areas where restoration is needed and the locations of the Upper Chinle compliance wells to cover these two restoration areas. Table 2-1 lists the compliance monitoring wells for the Upper Chinle aquifer. The completion information for these compliance Upper Chinle monitoring wells is presented in Tables 2-5 and 2-6 for the On-site and Off-site Chinle wells respectively. The compliance monitoring wells are distributed over the Upper Chinle aquifer for the Grants site. All of the Upper Chinle compliance monitoring wells have been added for coverage of the Upper Chinle restoration areas, except well CE9 which is a replacement well for Upper Chinle well 446. A sample has not been able to be produced from well 446 for the last several years. Wells CE2, CE8 and CW25 monitor the Upper Chinle downgradient of the tailings in this aquifer. Wells CW3, CF4, DE9 and CE15 will be used to define restoration in the Upper Chinle aquifer in these areas while wells 494, CW13 and CW18 define the Upper Chinle water quality changes downgradient of the site.

2.3 Middle Chinle Aquifer

Restoration is needed for the Middle Chinle aquifer in the On-Site and South Off-Site areas. Figure 2-4 shows the Middle Chinle areas that require restoration and shows the locations of compliance monitoring wells in the Middle Chinle aquifer. Restoration is needed in the Middle Chinle between the two faults in the Felice Acres and adjacent areas. Restoration is also needed in the Middle Chinle west of the West Fault in the area of well CW62 but is not required in the area to the north of well CW17 because these concentrations are natural. Wells have been selected to cover the Middle Chinle aquifer in the Grants site area and the restoration areas. Table 2-1 lists the Middle Chinle compliance wells for the Grants site while the well data for the On-site and Off-site Middle Chinle wells are given in Tables 2-5 and 2-6 respectively. All of these wells have been added to the Middle Chinle compliance monitoring program except well CW2 which was previously used to monitor Middle Chinle downgradient of the site. Middle Chinle wells 493, CW17, CW45, CW55, R3 and Y7 will be used to define restoration in these areas of the Middle Chinle aquifer while wells ACW, CW2, CW28 and CW76 monitor Middle Chinle downgradient of the restoration areas.

2.4 Lower Chinle Aquifer

Wells in the South Off-Site area will be used to restore the Lower Chinle aquifer in this area and Figure 2-5 shows the Lower Chinle area where restoration is needed and compliance wells to cover the Lower Chinle area. Wells have been selected in the restoration area of the Lower Chinle aquifer and also selected for coverage of other areas in the Lower Chinle aquifer. Table 2-1 lists the Lower Chinle compliance wells. Tables 2-5 and 2-6 present the completion information for the On-site and Off-site Lower Chinle compliance monitoring wells. Lower Chinle wells CW29, CW41, CW42 and V6 will be used to define the groundwater restoration in the Lower Chinle aquifer. Monitoring wells CW32 and CW43 will be used for downgradient monitoring in the Lower Chinle aquifer.

Table 2-1. Groundwater Monitoring at the Grants Site		
Well	Parameter List Code	Frequency of Monitoring
<i>Alluvial Background Wells</i>		
P, Q, 921	B, F	Annual
<i>Operational Monitoring</i>		
Collection system wells	Total Volume	Monthly
Injection system wells	Total Volume	Monthly
Reversal wells B, BA, KZ, DZ, SM, SN, S2, S5	Water Level	Weekly
<i>San Andres Wells</i>		
Deep #1R, Deep #2R, 943M, 951R	B, F H	Annual Semiannual
<i>Alluvial Compliance Monitoring Wells</i>		
On-Site Monitoring Wells (Evap. Ponds) DD, DD2, X	B, F plus Mn H	Annual Quarterly
Additional On-Site Monitoring Wells 1A, 1K, 639, 802, B11, D1, F, FB, GH, GN, L, L5, K9, M3, MX, MB, MQ, NC, S4, SUB3, T2, T19, T23, T41, T54	B, F	Annual
South Off-Site Wells 490, 497, 540, 631, 643#, 644, 864, 869, Q5, R3, SUB2	B, F	Annual
Section 34 Land application wells 555, 556, 557, 844, 845, 846	B, F	Annual
North Off-Site Wells(includes Section 28 Land application wells) 688, 881, 882, 883, 884, 886, 888, 893, 659, H2A, MR, H55, MO	B, F	Annual
Western Portion of North Off-Site Wells (Includes Section 33 Land application wells) 541, 551, 647, 649, 654, 899, 996	B, F	Annual
<i>Chinle Compliance Monitoring Wells</i>		
Upper Chinle Wells 494, CE2, CE8, CE9, CE15, CF4, CW3, CW13#, CW18, CW25#	B, F	Annual
Middle Chinle Wells 493, ACW, CW17, CW2, CW28, CW45, CW55, CW62, CW76, R3, Y7	B, F	Annual
Lower Chinle Wells CW29, CW32, CW41, CW42, CW43, V6	B, F	Annual

Note: # Monitoring will start after well ceasing to be used for injection

Table 2-2. Site Analytical Suites

Parameter List Code	Included Parameters (Dissolved)	Method	Reporting Limits	Units
B	Water level			s.u.
	pH	A4500-HB	0.01	
	Total dissolved solids (TDS)	A2540 C	20	mg/L
	Sulfate (SO ₄)	E300.0	4	mg/L
	Chloride (Cl)	E300.0	1	mg/L
	Bicarbonate (HCO ₃)	A2320 B	5	mg/L
	Carbonate (CO ₃)	A2320 B	5	mg/L
	Sodium (Na)	E200.7	0.9	mg/L
	Calcium (Ca)	E200.7	0.5	mg/L
	Magnesium (Mg)	E200.7	0.5	mg/L
	Potassium (K)	E200.7	0.5	mg/L
	Nitrate (NO ₃)	E353.2	0.1	mg/L
	Uranium (U)	E200.8	0.0003	mg/L
	Selenium (Se)	E200.8	0.005	mg/L
	Molybdenum (Mo)	E200.8	0.03	mg/L
	Radium-226 (Ra-226)	E903.0	Precision Variable	pCi/L
F	Vanadium (V)	E200.8	0.01	mg/L
	Radium-228 (Ra-228)	RA-05	Precision Variable	pCi/L
	Thorium-230 (Th-230)	E908.0	Precision Variable	pCi/L
H	Water Level			
	TDS	A2540 C	20	mg/L
	SO ₄	E300.0	4	mg/L
	U	E200.8	0.0003	mg/L
	Se	E200.8	0.005	mg/L
	Mo	E200.8	0.03	mg/L
	Cl	E300.0	1	mg/L

TABLE 2-3. WELL DATA FOR THE ALLUVIAL ON-SITE GROUNDWATER MONITORING

WELL NAME	NORTH. COORD.	EAST. COORD.	WELL DEPTH (FT-MP)	CASING DIAM (IN)	WATER LEVEL		MP ABOVE LSD (FT)	MP ELEV. (FT-MSL)	DEPTH TO BASE OF ALLUVIUM (FT-LSD)	ELEV. TO BASE OF ALLUVIUM (FT-MSL)	CASING PERFOR- ATIONS (FT-LSD)	SATURATED THICKNESS	
					DATE	DEPTH (FT-MP) (FT-MSL)							
SUB3	1538280	489420	84.0	6.0	10/26/2017	35.33	6521.74	0.0	6557.07	72	6485.1 A	58-72	36.7
1A	1543790	493768	61.0	5.0	8/18/2017	36.90	6548.53	2.9	6585.43	47	6535.5 A	39-51	13.0
1K	1541892	493275	55.6	5.0	3/22/2017	33.90	6550.23	1.0	6584.13	47	6536.1 A	30-55	14.1
B11	1542517	491329	84.9	5.0	7/14/2008	53.00	6524.39	2.2	6577.39	77	6498.2 A	42-80	26.2
D1	1542140	489615	89.4	4.0	6/28/2017	39.40	6531.50	1.0	6570.90	80	6489.9 A	58-90	41.6
DD	1546989	488943	78.5	4.0	10/12/2017	47.10	6545.49	1.9	6592.59	83	6507.7 A	40-80	37.8
DD2	1547439	489251	94.3	5.0	11/2/2017	45.40	6547.88	2.0	6593.28	80	6511.3 A	50-90	36.6
F	1538908	489554	63.8	4.0	3/17/2017	30.85	6533.97	1.2	6564.82	62	6501.6 A	45-65	32.3
FB	1540417	488857	62.0	4.0	3/17/2017	32.52	6533.14	2.0	6585.66	58	6505.7 A	43-58	27.5
GH	1538807	489509	69.2	4.0	3/17/2017	31.34	6531.42	1.3	6582.76	67	6494.5 A	55-65	37.0
GN	1538602	490944	116.5	4.0	8/14/2017	36.30	6531.67	1.8	6567.97	70	6486.2 A	50-120	35.5
K9	1541287	491787	86.0	5.0	3/31/2017	57.84	6542.50	2.0	6600.34	79	6519.3 A	56-86	23.2
L	1538970	492150	67.0	4.0	10/23/2017	57.34	6517.63	0.8	6574.97	59	6515.2 A	46-66	2.5
L5	1538946	492730	60.2	5.0	10/23/2017	51.55	6524.52	1.3	6576.07	50	6524.8 A	25-55	0.0
M3	1542805	489151	105.3	4.0	3/23/2017	40.15	6535.95	1.0	6578.10	—	— A	78-89	—
MB	1541296	487512	90.0	4.0	8/5/2000	2.05	6570.01	1.0	6572.06	85	6486.1 A	60-90	84.0
MQ	1543173	486326	98.0	5.0	8/19/2017	72.20	6502.10	1.6	6574.30	88	6484.7 A	58-88	17.4
MX	1541287	488244	103.0	5.0	8/11/2017	49.20	6519.41	1.7	6568.61	94	6472.9 A	63-103	48.5
NC	1545220	491282	95.0	4.0	12/13/2016	39.82	6548.01	0.8	6585.83	85	6500.0 A	65-95	48.0
P	1546691	491058	109.1	4.0	10/26/2017	39.59	6547.67	1.7	6587.26	107	6478.6 A	82-112	69.1
Q	1548693	492153	98.3	4.0	6/1/2017	70.27	6523.55	2.3	6593.82	100	6491.5 A	72-102	32.0
S4	1543344	488359	112.4	5.0	3/14/2017	37.30	6537.99	2.3	6575.29	108	6465.0 A	50-110	73.0
T2	1543538	489303	186.0	5.0	7/27/2015	114.46	6550.36	1.6	6664.82	180	6483.2 A	100-186	67.1
T19	1543958	490722	167.0	5.0	5/15/2015	112.83	6554.93	2.5	6667.76	162	6503.3 A	137-167	51.7
T23	1543901	492805	140.0	5.0	6/9/2015	112.64	6548.47	—	6681.11	140	— A	120-140	—
T41	1543278	491079	160.0	5.0	5/14/2015	82.85	6577.11	3.2	6659.96	155	6501.8 A	130-160	75.4
T54	1544523	489786	200.0	4.5	6/5/2014	110.08	6547.02	2.0	6657.10	—	— A	140-200	—
X	1540512	491892	50.7	4.0	10/26/2017	29.62	6541.99	1.7	6571.61	—	— A	-	—
0802	1540765	488277	98.0	6.0	8/8/2016	88.27	6474.45	2.0	6562.72	81	6479.7 A	75-81	0.0
0839	1538370	492961	80.0	5.0	4/27/2017	51.61	6536.27	2.5	6587.88	71	6514.4 A	35-80	21.9
0921	1555400	495800	—	5.0	10/22/2014	39.63	6584.37	1.9	6624.00	—	— A	-	—

Note: A = Alluvial Aquifer
 MP = Measuring Point
 LSD = Land Surface Datum
 IN = Inches
 FT = Feet
 MSL = Mean Sea Level

TABLE 2-4. WELL DATA FOR THE ALLUVIAL OFF-SITE GROUNDWATER MONITORING

WELL NAME	NORTH. COORD.	EAST. COORD.	WELL DEPTH (FT-MP)	CASING DIAM (IN)	WATER LEVEL			MP ABOVE LSD (FT)	MP ELEV. (FT-MSL)	DEPTH TO BASE OF ALLUVIUM (FT-LSD)	ELEV. TO BASE OF ALLUVIUM (FT-MSL)	CASING PERFOR-ATIONS (FT-LSD)	SATURATED THICKNESS
					DATE	DEPTH (FT-MP)	ELEV. (FT-MSL)						
SUB2	1537392	490370	—	4.0	5/28/2014	40.85	6528.72	0.0	6567.57	—	— A -	—	—
0490	1536553	489752	63.0	4.0	12/1/2015	24.50	6537.92	0.0	6562.42	75	6487.4 A	20-80	50.5
0497	1535039	489503	84.0	5.0	3/17/2017	50.00	6512.62	2.0	6562.62	89	6471.6 A	64-94	41.0
Q5	1534829	488945	100.0	4.5	3/4/2016	48.65	6512.83	2.8	6561.48	—	— A	60-100	—
0844	1538376	487002	75.0	4.0	3/27/2017	35.96	6520.17	1.2	6556.13	70	6484.9 A	35-75	35.2
0845	1537280	487833	65.0	4.0	3/27/2017	33.45	6523.60	1.7	6557.05	55	6500.4 A	45-65	23.2
0688	1541257	483955	105.0	5.0	8/9/2017	59.00	6503.62	2.9	6562.62	95	6484.7 A	65-105	38.9
0540	1534125	488091	80.0	6.0	11/16/2017	58.87	6497.04	2.7	6555.91	80	6473.2 A	30-90	23.8
0541	1539831	477236	120.0	5.0	12/28/2016	88.56	6467.06	2.0	6555.62	112	6441.6 A	78-118	25.4
0551	1536272	479881	135.0	5.0	3/28/2017	97.28	6450.02	2.1	6547.30	115	6430.2 A	95-135	19.8
0555	1538572	486236	100.0	5.0	3/27/2017	41.83	6515.31	2.5	6557.14	100	6454.6 A	60-90	60.7
0556	1538008	486184	100.0	5.0	3/27/2017	47.11	6508.91	2.4	6558.02	95	6458.6 A	60-90	50.3
0557	1537204	486000	65.0	5.0	2/10/2016	41.55	6512.22	2.5	6553.77	55	6496.3 A	45-65	16.0
0631	1532234	483756	118.0	6.0	6/30/2017	86.40	6454.70	2.2	6541.10	109	6428.9 A	58-118	24.8
0643	1533760	487386	108.0	5.0	10/18/2002	75.89	6475.44	1.5	6551.33	93	6456.8 A	58-108	18.6
0644	1533481	485450	110.0	5.0	11/6/2017	68.21	6475.69	2.0	6543.90	102	6439.9 A	55-110	35.8
0647	1536623	478308	140.0	4.5	3/15/2017	102.95	6448.96	1.4	6551.91	132	6418.5 A	80-140	30.5
0649	1534730	479798	124.0	4.5	3/15/2017	101.56	6441.73	0.3	6543.29	115	6428.0 A	84-124	13.7
0654	1541894	478636	120.0	4.5	12/12/2016	71.45	6478.05	1.4	6550.50	106	6443.1 A	60-120	36.0
0659	1541689	480772	101.0	4.5	3/20/2017	69.56	6490.61	2.0	6560.17	97	6481.2 A	81-101	29.4
0846	1537219	484730	75.0	4.0	8/9/2017	43.80	6505.12	0.8	6548.92	65	6483.1 A	40-65	22.0
0864	1533735	486484	95.0	5.0	8/9/2016	64.53	6482.19	1.9	6546.72	78	6466.9 A	44-84	15.3
0869	1533251	486073	94.0	5.0	11/3/2017	65.44	6479.05	1.7	6544.49	99	6443.8 A	44-94	35.3
0881	1542034	481478	96.0	4.5	2/23/2017	71.47	6493.57	2.0	6565.04	103	6460.0 A	76-96	33.5
0882	1541404	482398	110.0	4.5	3/15/2017	63.90	6497.26	2.0	6561.16	98	6461.2 A	70-110	36.0
0883	1540097	483039	100.0	5.0	11/30/2015	57.08	6500.05	1.9	6557.13	96	6459.3 A	60-90	40.8
0884	1542677	481498	90.0	5.0	3/27/2017	71.02	6495.08	1.0	6566.10	85	6480.2 A	58-88	14.9
0886	1542327	482487	90.0	5.0	11/8/2017	67.54	6497.01	1.5	6564.55	87	6476.1 A	60-90	21.0
0888	1542285	479335	105.0	5.0	10/6/2017	75.30	6482.03	1.1	6557.33	90	6466.2 A	75-105	15.8
0893	1541934	482244	98.0	4.5	3/14/2017	67.52	6496.45	2.1	6563.97	93	6468.9 A	78-98	27.6
0899	1543801	477288	110.0	4.0	10/3/2017	99.00	6471.84	2.0	6570.84	120	6448.8 A	70-110	23.0
0996	1537621	477989	138.0	5.0	12/5/2011	49.60	6502.92	1.7	6552.52	136	6414.8 A	126-136	88.1
H2A	1541694	479997	88.0	4.5	3/20/2017	72.50	6487.37	2.0	6559.87	88	6489.9 A	66-88	17.5
H55	1542809	484706	95.0	4.5	9/15/2014	60.00	6509.25	2.0	6569.25	95	6472.3 A	75-95	37.0
MO	1543620	485518	88.0	4.5	3/17/2017	62.05	6510.84	2.0	6572.69	80	6490.9 A	45-85	20.0
MR	1542809	483574	100.0	5.0	10/27/2017	88.71	6499.55	1.8	6568.26	100	6484.5 A	54-94	35.1
R3	1534546	488196	140.0	5.0	3/21/2017	55.07	6500.66	2.0	6555.73	88	6465.7 A	60-80	34.9
										88	6465.7 M	100-140	34.9

Note: A = Alluvial Aquifer
MP = Measuring Point
LSD = Land Surface Datum
IN = Inches
FT = Feet
MSL = Mean Sea Level

TABLE 2-5. WELL DATA FOR THE CHINLE ON-SITE GROUNDWATER MONITORING

WELL NAME	NORTH. COORD.	EAST. COORD.	WELL DEPTH (FT-MP)	CASING DIAM (IN)	WATER LEVEL			MP ABOVE LSD (FT)	MPELEV. (FT-MSL)	DEPTH TO AQUIFER (FT-LSD)	ELEV. OF AQUIFER (FT-MSL)	CASING PERFOR-ATIONS (FT-LSD)	AQUIFER
					DATE	DEPTH (FT-MP)	ELEV. (FT-MSL)						
CE9	1538203	489458	130.0	6.0	3/21/2017	60.40	6502.72	1.2	6563.12	—	—	U 90-130	Upper
CW55	1538283	489471	360.0	6.0	12/13/2016	53.92	6510.24	2.3	6564.16	260	6302	M -	Middle
CE2	1541923	489979	119.7	5.0	10/25/2017	78.90	6497.45	1.8	6576.35	74	6501	A -	—
										74	6501	U 78-118	Upper
CE8	1540704	491556	216.6	6.0	3/2/2017	34.33	6535.37	1.7	6569.70	166	6402	U 160-200	Upper
CE15	1539507	489460	130.0	5.0	3/21/2017	36.16	6529.92	2.0	6566.08	77	6487	U 90-130	Upper
CF4	1543680	490520	197.0	4.5	12/12/2016	126.15	6537.54	2.0	6663.69	166	6496	A -	—
										166	6496	U 177-197	Upper
CW2	1545212	491302	355.0	5.0	8/10/2017	106.70	6478.78	1.7	6585.48	85	6499	A -	—
										136	6448	U -	—
										305	6279	M 306-353	Middle
CW3	1545200	493496	235.0	5.0	12/13/2016	51.71	6535.47	0.7	6587.18	70	6516	A -	—
										209	6377	U 210-235	Upper
										348	6238	M -	—
CW13	1538349	491827	267.7	6.0	11/22/2010	0.55	6576.15	2.7	6576.70	230	6344	U 225-285	Upper
										378	6196	M -	—
CW17	1545279	487771	108.0	5.0	10/23/2017	55.00	6534.32	3.1	6589.32	73	6513	A -	—
										85	6501	M 83-103	Middle
CW25	1540802	488866	102.0	5.0	11/22/2010	0.92	6566.28	3.0	6587.20	53	6511	U 62-102	Upper
										53	6511	A -	—
CW62	1544555	487847	150.0	5.0	5/3/2017	89.54	6490.32	1.9	6579.86	60	6518	A -	—
										134	6444	M 130-150	Middle
ACW	1540235	488070	325.0	6.0	12/19/2016	78.58	6485.22	1.2	6563.80	40	6523	A -	—
										57	6506	U -	—
										264	6299	M 265-325	Middle

NOTE: A = Alluvial Aquifer, Base
 U = Upper Chinle Aquifer, Top
 M = Middle Chinle Aquifer, Top
 L = Lower Chinle Aquifer, Top
 * = Abandoned

TABLE 2-6. WELL DATA FOR THE CHINLE OFF-SITE GROUNDWATER MONITORING

WELL NAME	NORTH. COORD.	EAST. COORD.	WELL DEPTH (FT-MP)	CASING DIAM (IN)	WATER LEVEL			MP ABOVE LSD (FT)	MP ELEV. (FT-MSL)	DEPTH TO AQUIFER (FT-LSD)	ELEV. OF AQUIFER (FT-MSL)	CASING PERFOR-ATIONS (FT-LSD)	AQUIFER
					DATE	DEPTH (FT-MP)	ELEV. (FT-MSL)						
0493	1536702	489492	300.0	5.0	3/1/2017	68.43	6491.85	0.9	6560.28	40	6519 A	-	---
										65	6494 U	-	---
										236	6323 M	270-300	Middle
0494	1536689	489494	85.0	5.0	6/28/2017	33.90	6526.24	0.6	6560.14	40	6520 A	-	---
										65	6495 U	65-85	Upper
CW45	1535036	489494	193.0	5.0	3/24/2017	53.75	6507.56	0.6	6561.31	90	6471 A	-	---
										166	6395 M	163-193	Middle
Y7	1535339	488870	220.0	4.5	3/28/2017	68.27	6492.16	2.5	6560.43	90	6468 A	-	---
										158	6400 M	180-220	Middle
CW18	1535924	491378	230.7	5.0	3/20/2017	38.45	6534.20	1.5	6572.65	90	6481 A	-	---
										190	6381 U	177-232	Upper
										340	6231 M	-	---
CW28	1535112	491008	370.0	5.0	12/12/2016	72.01	6499.67	1.9	6571.68	90	6480 A	-	---
										110	6460 U	-	---
										294	6276 M	280-360	Middle
CW29	1534551	487435	290.0	5.0	3/20/2017	75.50	6476.72	1.7	6552.22	52	6499 M	-	---
										52	6499 A	-	---
										228	6323 L	230-270	Lower
CW32	1543413	483523	300.0	6.0	6/29/2017	148.40	6418.88	1.7	6567.28	77	6489 A	-	---
										157	6409 L	218-303	---
										157	6409 L	158-188	Lower
CW41	1533174	488584	206.0	6.0	12/12/2016	76.00	6479.41	1.5	6555.41	59	6495 A	-	---
										138	6416 L	146-206	Lower
CW42	1533169	487177	205.0	6.0	8/14/2017	66.90	6481.88	0.0	6548.78	98	6451 A	-	---
										124	6425 L	125-205	Lower
CW43	1537587	482493	104.1	5.0	12/20/2016	67.80	6480.99	2.0	6548.79	57	6490 A	-	---
										57	6490 L	81-101	Lower
CW76	1536661	487861	270.0	4.5	5/4/2017	69.26	6487.35	2.4	6556.61	40	6514 A	-	---
										210	6344 M	230-270	Middle
R3	1534546	488196	140.0	5.0	3/21/2017	55.07	6500.66	2.0	6555.73	88	6466 A	60-80	Alluvium
										88	6466 M	100-140	Middle
V6	1534158	485711	260.0	4.5	8/22/2017	73.60	---	2.0	---	220	---	L 220-260	Lower

NOTE: A = Alluvial Aquifer, Base
U = Upper Chinle Aquifer, Top
M = Middle Chinle Aquifer, Top
L = Lower Chinle Aquifer, Top
* = Abandoned

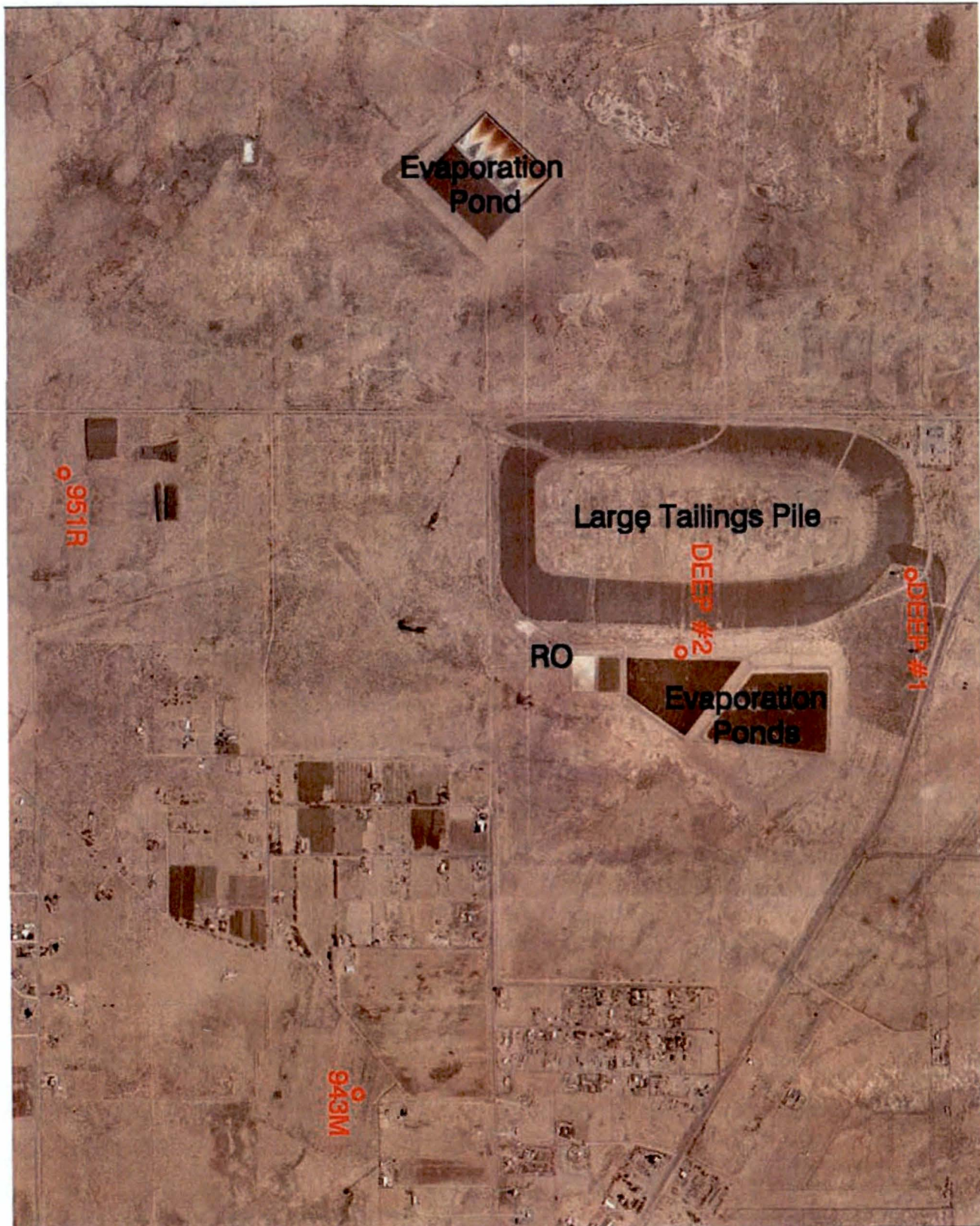
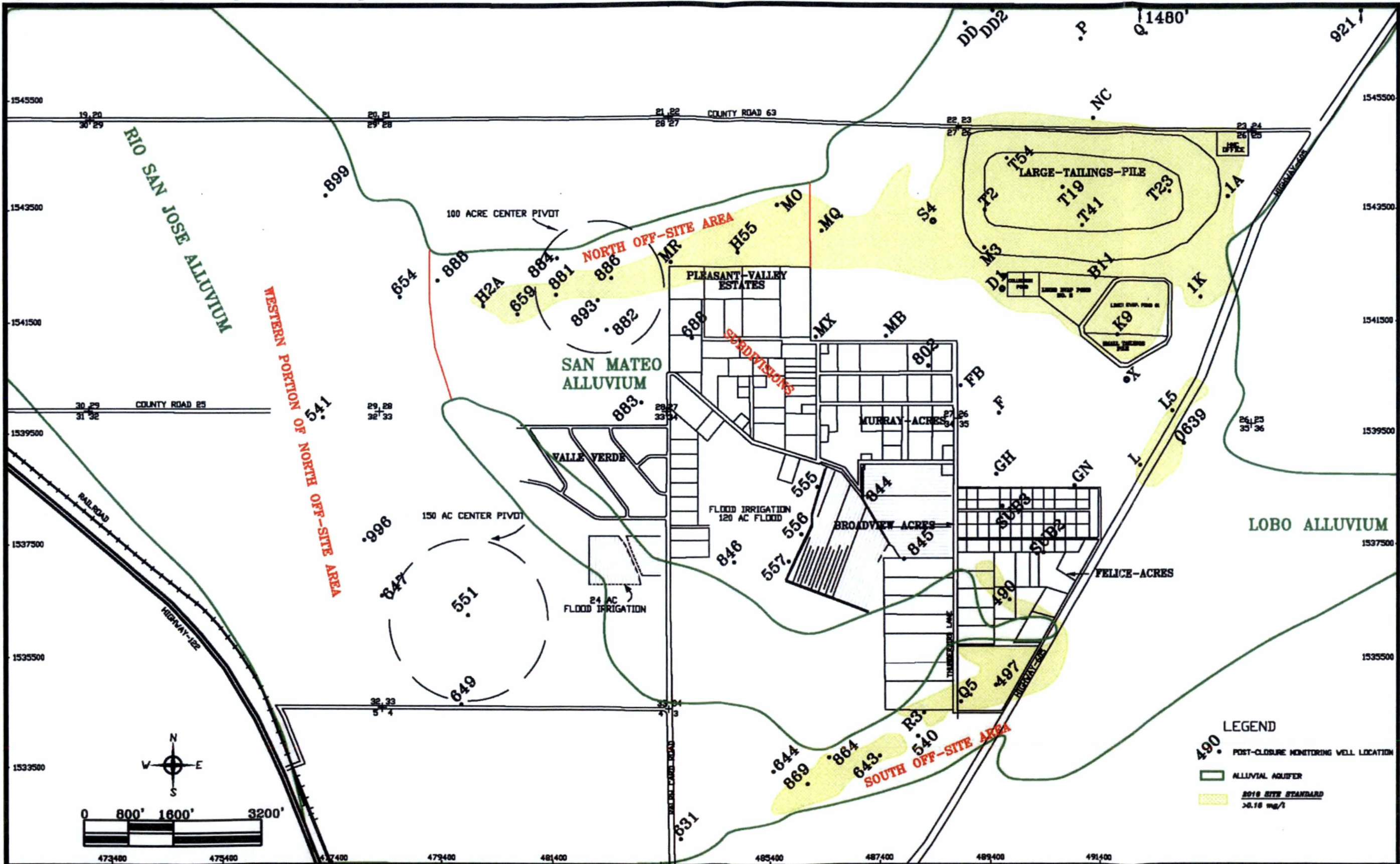


Figure 2-1. San Andres Aquifer Monitoring Well Locations

Figure 2-2. Alluvial Aquifer Compliance Monitoring Well Locations





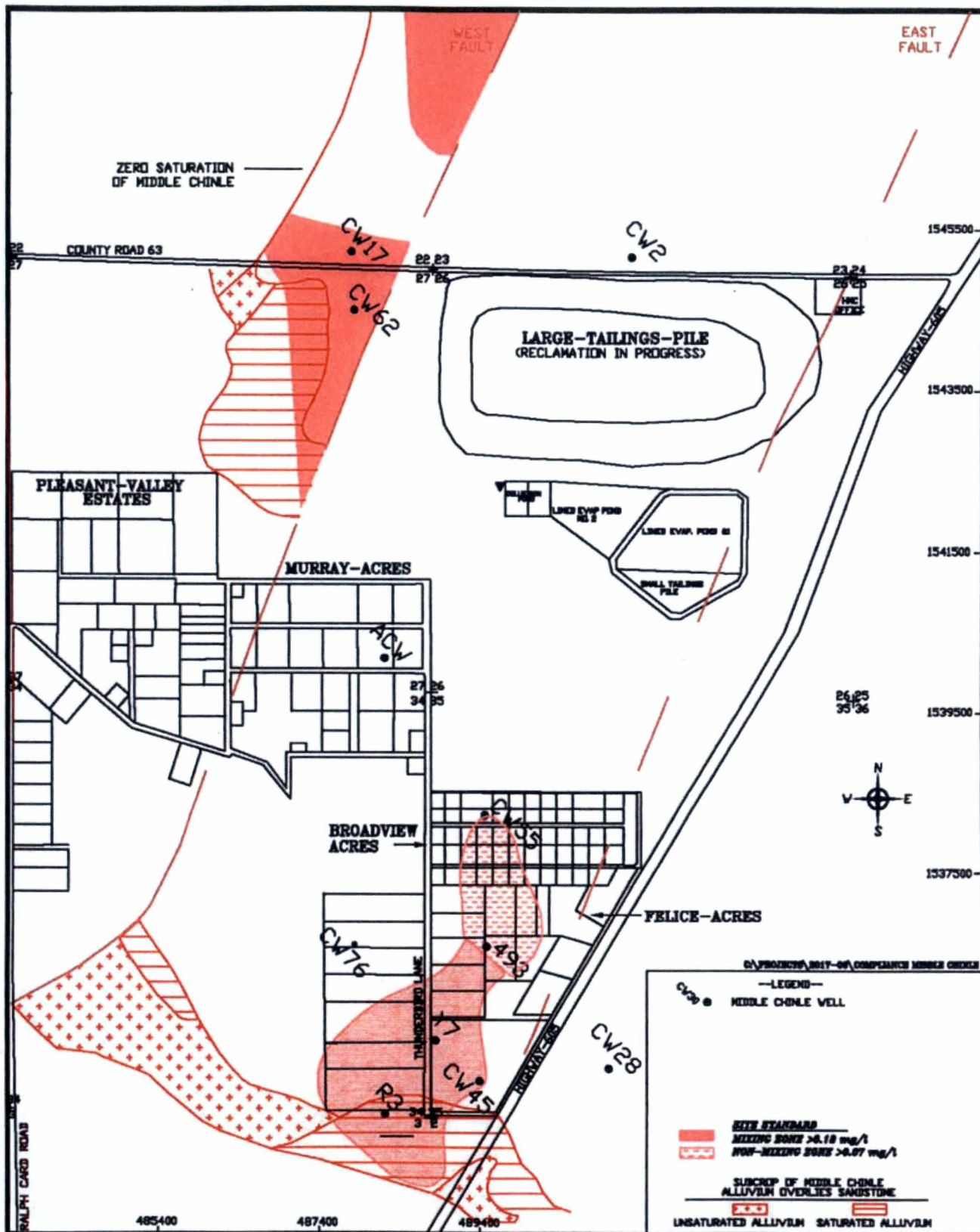
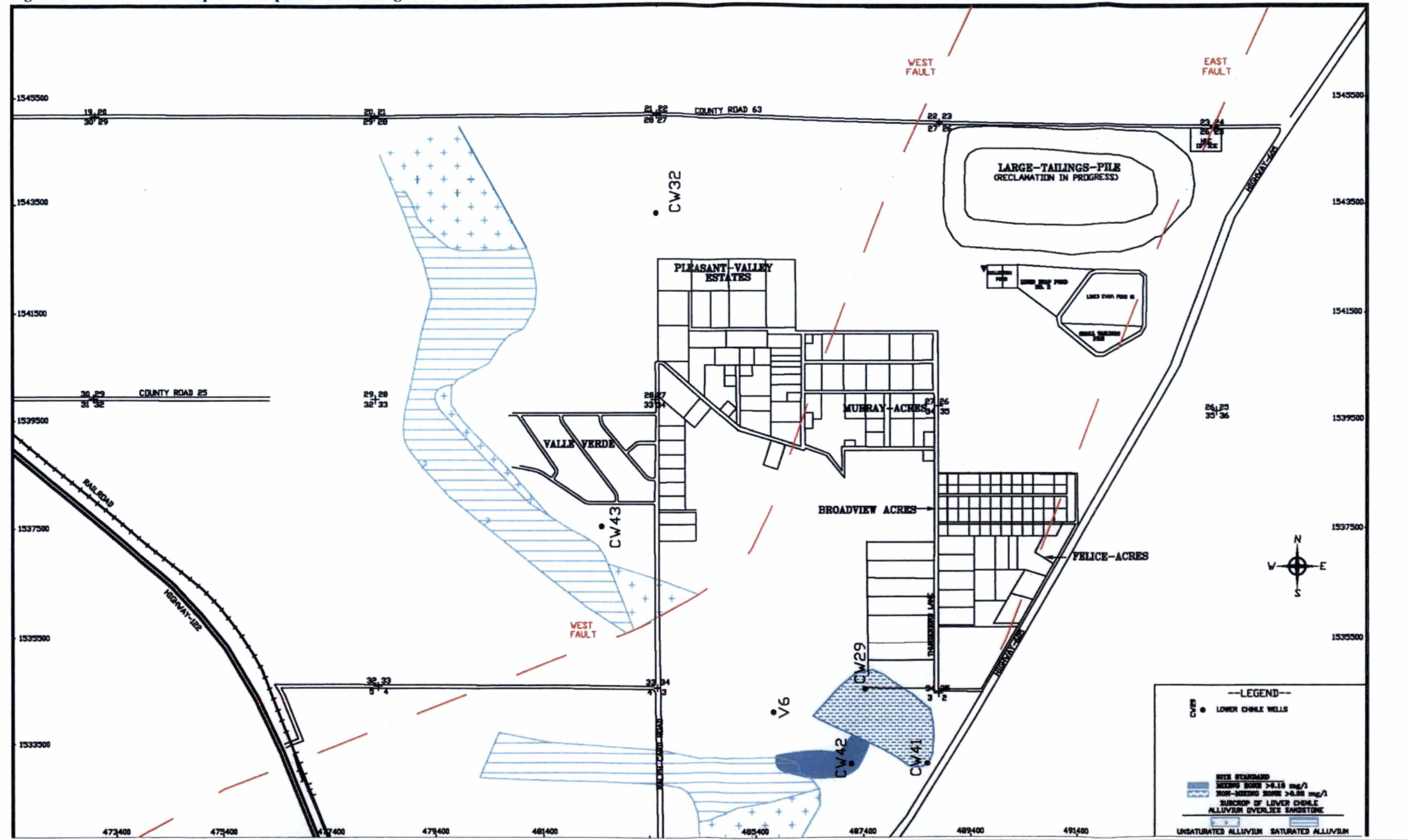


Figure 2-4. Middle Chinle Aquifer Compliance Monitoring Well Locations

Figure 2-5. Lower Chinle Aquifer Compliance Monitoring Well Locations



3. REFERENCES

New Mexico Environment Department, 2014, Ground Water Quality Bureau, Ground Water Discharge Permit DP-200, Renewal and Modification.

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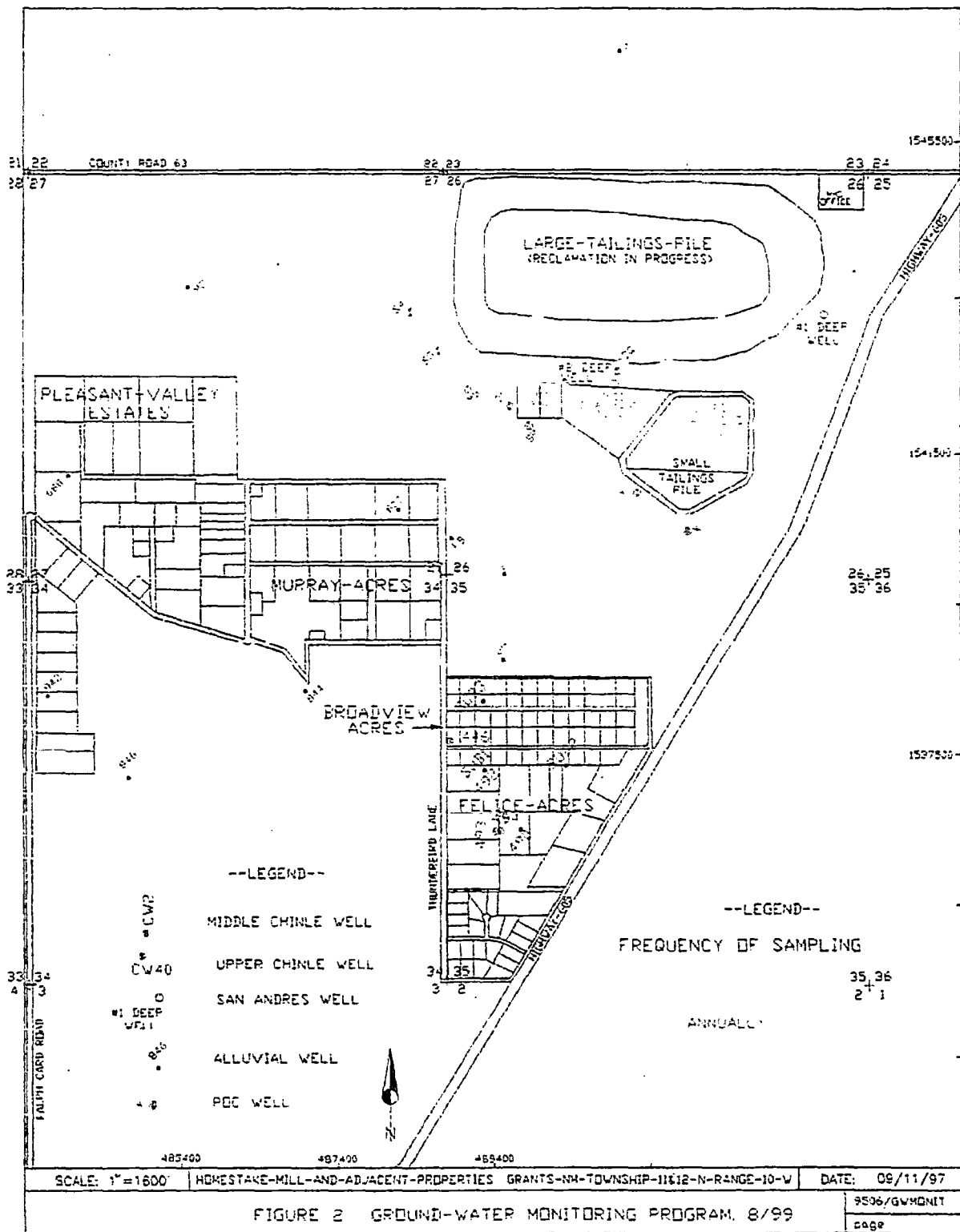
APPENDIX A
Grants Site Existing Groundwater Monitoring

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NRRC's Revised TABLE 2 (8-99)

Well Number	Parameters to be Monitored	Frequency of Monitoring
#1 & 2 Deepwells	D	Annually
Broadview Acres Wells 446, SUB1, SUB2, SUB 3	G	Annually
Felice Acres Wells 490, 492, 493, 494	G	Annually
Murray Acres Wells 802, 844	G	Annually
Pleasant Valley Wells 688, 846	G	Annually
Regional Wells 920, 942	G	Annually
Site Monitoring Wells F, FB, GH, MO, CW2	G	Annually
Collection System Wells	Total Volume	Monthly
Injection System Wells	Total Volume	Monthly
Reversal Wells B, BA, KZ, KF, SO, SP, S1, S2	Water Level	Weekly
Point of Compliance Wells D1, X, S4	B, F	Annually
Background Well P	B	Annually

- B: Water Level, pH, TDS, SO₄, Cl, HCO₃, CO₃, Na, Ca, Mg, K, NO₃, U, Se, Mo, Ra-226
- D: Ca, Mg, K, Na, HCO₃, CO₃, Cl, SO₄, pH, TDS, Al, As, Ba, Cd, Co, Cu, CN, F, Fe, Pb, Mn, Hg, Mo, Ni, NO₃ as N, Se, Ag, Zn, U, Filtered Ra-226
- F: V, Ra-228, Th-230
- G: Water Level, SO₄, U, Se, TDS, Mo



Appendix C
Preliminary Groundwater Flow and Transport Model Status Report

HOMESTAKE MINING COMPANY OF CALIFORNIA

Grants Reclamation Project



**PRELIMINARY GROUNDWATER FLOW AND TRANSPORT MODEL STATUS
REPORT**

March 2019

**U.S. Nuclear Regulatory Commission License SUA-1471
State of New Mexico DP-200**

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List of Abbreviations

amsl	above mean sea level	RMM	reformulated mixing model
ASTM	American Society for Testing and Materials	RMSE	root mean squared error
BC	Brown and Caldwell	RO	reverse osmosis
CAP	Corrective Action Plan	SAG	San Andres/Glorieta
CEC	cation exchange capacity	SCM	surface complexation models
CGM	conceptual geochemical model	SCMM	surface complexation and mixing model
cm ³	cubic centimeter/centimeters	SI	saturation index
COCs	constituents of concern	SMC	San Mateo Creek
d	day(s)	STP	small tailings pile
DEM	digital elevation model	TDS	total dissolved solids
DO	dissolved oxygen	U.S. DOE	United States Department of Energy
Eh	redox potential	USEPA	United States Environmental Protection Agency
EP	evaporation pond	USGS	United States Geological Survey
ft	foot/feet	WME	Worthington Miller Environmental, LLC.
ft ²	square foot/feet	XRD	X-Ray Diffraction
ft ³	cubic foot/feet		
g	gram/grams		
gpm	gallon(s) per minute		
GIS	geographic information system		
GRP	Grants Reclamation Project		
HE	Hydro—Engineering, LLC.		
HMC	Homestake Mining Company of California		
HSCM	hydrogeologic site conceptual model		
K _d	distribution coefficient		
K _f	Freundlich isotherm partition coefficient		
Kg	kilogram/kilograms		
L	liter(s)		
LGR	local grid refinement		
LTP	large tailings pile		
m ²	square meter/meters		
mg	milligram(s)		
NRC	U.S. Nuclear Regulatory Commission		
ppm	parts per million		
PRISM	Parameter-Elevation Regressions on Independent Slopes Model		
R _r	retardation factor		
RI	Remedial Investigation		

Section 1: Introduction

Homestake Mining Company of California (HMC) is currently developing a combined Groundwater Flow and Transport Model that includes San Mateo Creek (SMC) Basin in west-central New Mexico and HMC's Grants Reclamation Project (GRP) at the HMC Mill site (Site), located near Grants New Mexico. This status report details on-going groundwater model development progress with a specific focus on the GRP, including both geochemical modeling and preliminary groundwater flow and transport calibration results. As the model is regularly updated, it will continue to be used to evaluate GRP groundwater restoration activities and as a tool to predict effectiveness of future remediation efforts including fate and transport of site constituents of concern (COCs). This model will also be used to support completion of a revised Groundwater Corrective Action Plan (CAP) for the GRP and, thus, the model includes simulation of the following key hydrogeologic components of the site conceptual model:

- Groundwater flow and hydraulic heads within the alluvial and bedrock (upper, middle and lower Chinle and San Andres) aquifers beneath the GRP.
- Fate and transport of site COCs associated with the GRP.

In March 2018, HMC submitted a Groundwater Flow and Transport Modeling Work Plan (Work Plan) for the GRP to the U.S. Nuclear Regulatory Commission (NRC) (HMC, 2018a). The Work Plan outlined a recommended approach for development of a new groundwater flow and transport model spanning the entire SMC Basin, including the area of the GRP. The Work Plan described development of both a site-specific model and a simplified regional scale model that would be coupled using an advanced MODFLOW modeling technique known as Local Grid Refinement (LGR). After additional consideration, this methodology was deemed unnecessarily complicated because matching grid and layer structures between the regional and site-scale models would be required. An alternative approach was implemented where a single regional-scale model covering the entire SMC Basin has been developed. The alternative modeling approach was described in a modeling progress update Memorandum dated October 2018 (HMC, 2018b).

1.1 Background Information

The HMC Mill site (Site) is located approximately 6 miles north of Milan in the SMC Basin, which encompasses an area of approximately 321 square miles and is shown by the blue outline on Figure 1-1. The SMC Basin includes the Grants Mineral Belt, which produced more uranium than any other district in the world during the period 1951–1980 (HDR, 2016). There are more than 85 legacy mining and mill sites in the SMC Basin and mining and remediation activities have had a significant impact on local and regional groundwater.

Significant remedial activities have occurred at four uranium mill sites in the SMC Basin, which are shown on Figures 1-1 and 1-2. These include the HMC Mill site and Bluewater Mill site in the lower (southern) SMC Basin, which is defined as the portion below the confluence of San Mateo Creek and the Arroyo del Puerto (Figure 1-2). The Rio Algom/Quivira Mill Site (also referred to as the Ambrosia Lake Mill site) and the Phillips Mill Site in the Ambrosia Lake area are located in the upper (northern) SMC Basin about 12 miles north of the HMC Mill site (Figure 1-2). Significant groundwater data have been collected at these sites associated with past and ongoing remedial activities.

HMC Mill site features are shown on Figure 1-3, and include former uranium milling operation areas, tailings piles, collection and evaporation ponds, and support facilities. At the HMC Mill site, uranium milling operations occurred from 1958 until 1990. Closure activities occurring at the site include security, groundwater

remediation operations, and environmental monitoring (HDR, 2016). Ongoing site remedial activities are collectively referred to as the GRP and have been ongoing since 1977.

Past remedial activities at the GRP have been described in detail in both the Work Plan (HMC, 2018a) and the Draft Remedial Investigation (RI) Report (HDR, 2016). The goal of remediation has been to reduce the concentrations of COCs in underlying aquifers to levels meeting designated standards. The current system includes multiple components that are frequently adjusted based on evaluation of monitoring data. The primary components of the current system are summarized as follows:

- **Hydraulic Containment** – Groundwater extraction from and reinjection into the alluvial, Upper Chinle, and Middle Chinle aquifers creates a hydraulic barrier to limit the movement of contaminated groundwater. The hydraulic barrier in the alluvial aquifer is created and maintained downgradient of the Large Tailings Pile (LTP) with dozens of wells used to extract impacted groundwater and to introduce clean water into the alluvium with more than 6,000 linear feet (ft) of infiltration lines (HMC, 2012). Water added to the alluvial formation used to create the hydraulic containment area is derived from the reverse osmosis (RO) plant product water, treated effluent from the zeolite pilot testing systems, and the San Andres Limestone/Glorieta Sandstone (SAG) aquifer.
- **Groundwater Extraction and RO Treatment** – Groundwater is extracted from numerous dewatering wells and tailing pile toe drains upgradient of the hydraulic barrier created by injected water. Extracted groundwater is routed primarily to the RO treatment plant to remove contaminant mass, or to evaporation ponds if RO capacity is unavailable. RO is the primary treatment process by which COCs are removed, along with the zeolite pilot-testing system. Plant influent is composed primarily of groundwater from the alluvial, Upper Chinle, and Middle Chinle aquifers (approximately 90 percent) and West Collection Pond water (approximately 10 percent), which receives groundwater and tailings water suitable for treatment, along with miscellaneous overflows from the RO plant. As described in the 2017 Annual Monitoring Report / Performance Review (HMC and Hydro-Engineering [HE], 2018), in 2017, approximately 364 gallons per minute (gpm) of RO plant influent came from the alluvial aquifer collection wells, 53 gpm from Collection Ponds, 100 gpm from Upper Chinle aquifer extraction wells, and 32.7 gpm from Middle Chinle aquifer extraction wells.
- **Evaporation** - There are three lined evaporation ponds (EP-1, EP-2, and EP-3) in use at the HMC Mill site (Figure 1-3) that are used for site remediation. The evaporation system is used primarily for water disposal and receives brine from the RO plant, regeneration water from the zeolite system, and the tailings sumps. In 2017, average evaporation from the ponds was approximately 225 gpm, while receiving an average of 8.4 gpm from the tailings extraction wells, 108 gpm of brine from the RO plant, 33 gpm from precipitation, 50 gpm from the zeolite pilot testing systems, and 23 gpm from collection ponds (HMC and HE, 2018).

Groundwater extraction, injection, and hydraulic containment are key components for groundwater flow and transport model development for the GRP. In general, source and plume control measures have reduced the concentrations of COCs in tailings and the areal extent of observed contaminant plumes. Figure 1-4 shows the extent of the uranium plume in the Alluvial aquifer for years 1999 and 2017 where total affected areas have decreased by nearly 40% (1,108 acres to 678 acres).

1.2 Groundwater Flow and Transport Modeling Objectives

Groundwater flow and transport modeling for the HMC Mill site and surrounding SMC Basin is being used as a tool to assess recent, current, and potential future changes in groundwater flow and COC transport as a result of the ongoing remedial activities described above. The eventual goal is to develop a single model encompassing the entire SMC Basin that can be used to simulate both current GRP groundwater restoration activities and as a tool to predict system changes in response to basin-wide remediation efforts, including an

understanding of the long-term fate and transport of COCs. The initial focus of model development and calibration, and the subject of this report, has been to reasonably simulate observed flow and COC transport conditions in the vicinity of the GRP. A generalized representation of flow in the surrounding regional aquifers has been developed to set water levels and regional groundwater inflows and outflows to the focused GRP area.

Both model development and this report have been developed based on applicable ASTM International (ASTM) Standards (ASTM, 2006; ASTM, 2008) and in general accordance with NRC guidance (Neuman and Wierenga, 2003). Section 2 of this Preliminary Model Development Report provides a summary of the Hydrogeologic Site Conceptual Model (HSCM), which form the basis of numerical model development. Section 3 describes development of the GRP numerical groundwater model, while model groundwater flow calibration is outlined in Section 4. Section 5 presents results of geochemical modeling and groundwater transport model calibration discussion for uranium and molybdenum. Results of sensitivity analyses are included in Section 6, and Section 7 includes a summary and discussion of future modeling activities.

Section 2: Hydrogeologic Site Conceptual Model

The HSCM was developed for the San Mateo Creek (SMC) Basin and is described in detail in a technical memorandum (BC, 2018). The HSCM forms the framework for development of numerical groundwater flow and contaminant transport model for the San Mateo Creek Basin, which also includes the Grants Reclamation Project. A HSCM is a summary of available knowledge related to groundwater flow and water quality of the principal hydrostratigraphic units at a certain location and scale. Elements of the HSCM form the basis for numerical model development, including the lateral model domain extents, model layer structures, boundary conditions, physical parameterizations, and calibration approaches described in Sections 3 and 4.

Regionally, the SMC Basin is located in the southeastern portion of the Colorado Plateau physiographic province on the south flank of the San Juan Basin. Figure 2-1 shows the general area in northern New Mexico underlain by the San Juan Basin, while Figure 2-2 presents a geologic cross section illustrating the principal stratigraphic units. The region experienced structural deformation during the Laramide Orogeny from near the end of the Late Cretaceous through the Eocene. Uplift associated with this orogeny formed the Zuni Mountains to the southwest of the SMC Basin, which consists of a northwest-trending monoclinial fold dipping northeast into the San Juan Basin. The SMC Basin lies on the eastern flank of the fold, resulting in bedrock and strata that dip to the north-northeast at about 5 to 10 degrees into the San Juan Basin.

Surface geology in the SMC Basin is shown on Figure 2-3. The primary regional aquifer units in the SMC Basin are as follows (from youngest to oldest):

- Quaternary valley fill deposits (alluvium)
- Menefee Formation
- Point Lookout Sandstone
- Crevasse Canyon Formation
- Gallup Sandstone
- Dakota Sandstone
- Morrison Formation
- Bluff Sandstone
- Entrada Sandstone
- SAG aquifer

The Morrison Formation, Entrada Complex, and SAG are considered the major aquifers in the SMC Basin. Figure 2-4 presents a geologic cross section through the central portion of the SMC Basin illustrating the aquifer units.

The SMC Basin is primarily a region of recharge to groundwater, both to shallow and deeper hydrostratigraphic units. Figure 2-5 shows the general regional groundwater flow patterns for aquifer units that receive recharge within the SMC Basin. Groundwater recharge, discharge, and flow characteristics as well as aquifer physical properties for each of the principal aquifers in the SMC Basin are provided as part of the Regional HSCM (BC, 2018). The effects of groundwater extraction in the alluvial, Morrison Formation, and SAG aquifer on regional flow conditions are also presented. The main structural features in the SMC Basin consist of north- to northeast-trending sub-vertical normal faults, which may locally either impede or facilitate groundwater flow, depending on orientation and offset.

Key elements of the HSCM for the SMC Basin are summarized as follows:

- The SMC Basin is located at the southern margin of the San Juan Basin.
- Aquifers of Quaternary, Cretaceous, Jurassic, and Permian age units are present in the SMC Basin.
- Principal regional aquifers that may have significant flow in the SMC Basin include the alluvium, Menefee, Point Lookout, Gallup, Morrison, and SAG aquifers.
- Geologic uplift of the Zuni Mountains on the southwest edge of the SMC Basin has exposed outcrops of the principal aquifers. Aquifer units generally dip to the north-northeast toward the central portion of the San Juan Basin.
- Flow directions in the Cretaceous and Jurassic aquifers are variable but generally toward the east-northeast from outcrops and subcrops in the SMC Basin toward discharge to the Rio Puerco watershed.
- Regional groundwater flow in the Permian SAG aquifer is generally to the east and southeast, with discharge occurring southeast of Grants via upward flow to alluvium of the Rio San Jose.
- Hydraulic conductivities and other aquifer parameters typically vary greatly between units, vertically within many units, and even areally within some units in the basin.
- Historical groundwater pumping has occurred primarily in the alluvial Morrison, and SAG aquifers.
- Extensive pumping from the Morrison Formation in the Ambrosia Lake area between the late 1950s and early 1980s resulted in significant water level declines in the aquifer. Water levels in this area are recovering after the cessation of pumping, but few water-level data are available to evaluate system recovery.
- Groundwater pumped from the Morrison Formation in the Ambrosia Lake area for dewatering of uranium mines was discharged into local drainages including the Arroyo del Puerto. This discharge provided significant recharge to previously unsaturated alluvium, and this water still persists in the alluvial system.
- The SAG aquifer represents the primary regional source of groundwater. Extensive pumping from the aquifer has occurred since the 1940s for irrigation, municipal, and industrial uses.
- Long-term pumping in the SAG aquifer has produced local-scale and regional-scale drawdowns in the aquifer.
- In general, there is little evidence of inter-aquifer flow in the basin, which is due to the presence of low-permeability aquitards between the principal aquifers.

- High-angle normal faulting has locally affected groundwater flow in bedrock aquifers, including near the Bluewater and HMC Mill sites, where local faulting has been shown to restrict groundwater flow.

Key HSCM elements specific to the GRP include:

- The HMC Mill site is located in the southern (lower) portion of the SMC Basin.
- Aquifers of Quaternary, Triassic, and Permian age are present at the site.
- Principal aquifers with groundwater flow at the site include the alluvium; Upper, Middle, and Lower transmissive units of the Chinle Formation; and SAG aquifer.
- Local groundwater flow in the alluvium generally flows parallel to downgradient surface flows in SMC, the Rio Lobo, and the Rio San Jose, but bifurcates around a bedrock high located south of the LTP.
- Groundwater flow in the Chinle Formation aquifer units is generally to the north-northeast, except where influenced by faulting, subcrop locations, or ongoing restoration operations. Groundwater flow in the underlying SAG aquifer is more to the east and southeast.
- Site remedial activities have included groundwater extraction and injection in both the alluvium and Chinle sandstones, affecting local groundwater flow conditions.
- The presence of fault zones has restricted and redirected local groundwater flow in the Chinle aquifers under the GRP.
- Local groundwater flow conditions have been well characterized through data collected from hundreds of monitoring wells on the GRP.

These elements of the HSCM were generally translated into the GRP Model as described in Section 3.

As an initial step toward creating a groundwater flow and transport model, a 3-D geologic model was developed that captures stratigraphy and faulting at both the site scale around the GRP and regionally within the SMC Basin. The geologic model was then used to create appropriate hydrostratigraphic layer structure in a USGS MODFLOW environment. The geologic model was developed using Leapfrog™, a geologic modeling software that provides for enhanced interpretation and visualization of regional stratigraphy and geology. Development of the regional Leapfrog 3-D geologic included the incorporation of an existing site-scale geologic model's interpretations of surface outcrops, stratigraphic layer thicknesses, fault structures, dip directions, and dip angles to produce "layer cake" representation of the primary stratigraphic units in the SMC Basin in the vicinity of the GRP (HMC, 2012). Information from geologic logs collected at the site, along with regional well information (well depths and units penetrated) were added and localized changes were made to stratigraphic thicknesses and depths to expand the model regionally to the scale of the SMC Basin, such that the model reflects available geologic data. 3-D geologic model development ended with the addition of primary regional fault structures and assumed stratigraphic offsets related to these structures. Overall, approximately 1,437 well logs were used to inform the basin-scale 3-D geology model in addition to 14 geologic maps for the region (see References for data sources).

Figures 2-6 through 2-8 provide representative cross sections through the SMC Basin that were generated using the 3-D geologic model. Representations of regional stratigraphy developed from the 3-D geologic model were then translated to MODFLOW format for development of the GRP Model layer structure described in Section 3.3.

Section 3: GRP Numerical Model Development

This section discusses development of GRP Model. The GRP Model consists of a groundwater flow model to simulate system responses to changes in background hydrologic conditions and site remediation pumping/injection activities, and a solute transport model to simulate changes in constituent concentrations in response to ongoing remediation activities. Model code selection is described immediately below.

3.1 Model Code Selection

The GRP Model was developed based on MODFLOW-NWT, a version of the popular U.S. Geological Survey family of MODFLOW groundwater flow modeling codes (Niswonger et al., 2011). MODFLOW-NWT includes the Newton-Raphson solution formulation that enables improved unconfined groundwater flow simulations and incorporates code changes that better simulate drying and rewetting, which may occur within the GRP and SMC Basin if sufficient water table declines and increases are predicted. MODFLOW-NWT is maintained by the U.S. Geological Survey and is publicly available.

3.2 Simulation Period

The current version of the GRP groundwater model simulates a transient calibration period of 2013 through 2017 using stress periods that contain variable time lengths. A steady state solution was developed for 2013 that provides the initial condition for the transient model. A simulation that consisted of a predevelopment steady state condition followed by a transient model covering the period of 1940 through present day was considered but lack of historical SMC Basin data availability (especially historical dewatering records) would prevent this model from reasonably approximating actual Basin conditions.

From 2013 through 2016, each year contains two stress periods that are 6-months in length. At the time of model development, pumping and injection associated with 2017 was projected and therefore an annual stress period was used for this year. The overall simulation period and stress period durations will likely be a focus of future work. For example, if additional historical pumping and injection data for the GRP site (e.g., 2005 through 2012) can be reliably estimated, the simulation period may be lengthened to include additional years of historical operations.

3.3 Model Domain & Layering

The GRP Model domain encompasses the principal regional aquifers present in the basin and the regional SAG aquifer. The full model extent is shown on Figure 3-1, which was designed to include both north to northeast flow in the Cretaceous, Jurassic, and Triassic aquifers and east to southeast flow in the underlying SAG (Permian) aquifer. The regional extent of the model also generally corresponds to the SMC Basin watershed boundary to the north and east. The domain was expanded to the south and west to include areas up-gradient of Bluewater, the Grants-Milan area, and mountain front recharge to the SAG, which occurs in the Zuni Mountains.

Active model areas not immediate to the GRP generally contain uniform grid spacing of 500 by 500 ft, which is adequate to simulate representative regional flow conditions. Grid refinement is implemented near the GRP with grid cell sizes decreasing to 62.5 ft by 62.5 ft, where the smaller areas are appropriate for simulation of both constituent transport and fluxes from the numerous Site wells associated with the GRP extraction/injection system (Figure 3-2). The variably spaced grid includes 449 rows and 490 columns, with a total of 1,738,207 active model cells.

Initial efforts to develop the regional model construct included 18 layers, which allowed very detailed representation of hydrostratigraphic units found beneath both the GRP area and at the regional basin scale. Initial model layering was created as summarized in Table 3-1. The 18-layer model construct led to simulations

with very long run times and solution nonconvergence issues using MODFLOW-NWT. To address this problem, certain layers were lumped together where appropriate to reduce the overall complexity of the model. The simplified 10-layer model honors critical hydrostratigraphic units at the GRP area but aggregates regional bedrock formations located north and northeast of the GRP. This 10-layer groundwater flow model is characterized by reduced run times and convergent solutions and this construct is also summarized in Table 3-1 and shown graphically in Figure 3-3.

Since model layers were defined by hydrostratigraphy, where geologic units do not exist at a location due to erosion, the corresponding model layers are assigned nominal thicknesses of 1 foot each and are assigned the hydraulic properties of the uppermost existing geologic unit. For example, at a location where the Middle Chinle aquifer (model layer 6) is sub-cropping beneath alluvium, model layers 2, 3, 4, and 5 are assigned the nominal thickness of 1 foot and the hydraulic properties of the Middle Chinle aquifer. The thickness of model layer 6 is reduced by the total thickness of the overlying nominal thickness layers (i.e., 4 feet) to preserve the overall transmissivity of the Middle Chinle aquifer. This approach allows for appropriate simulation of continuous flow and transport between the Middle Chinle aquifer subcrop and the overlying alluvium (see Section 3.4 for figure representations). Using nominal thicknesses of less than 1 foot for each layer (e.g., 0.1 foot each) were initially tested and led to numerical instabilities and solution nonconvergence issues in MODFLOW-NWT.

Cross sections through the GRP as they are represented in the MODFLOW-NWT model are provided in Figures 3-4 and 3-5. The model grid rotation is 23 degrees to maintain an orientation that generally aligns with principal hydraulic conductivity and observed primary transport directions, so a single row cross section from the model trends slightly from northwest to southeast whereas a column trends from southwest to northeast.

As part of future efforts, Layer 2 of the current construct may be revisited and subdivided such that additional regional hydrostratigraphic details are represented by the groundwater model, if runtimes are manageable and model convergence is maintained.

Table 3-1 - Initially Proposed Layer Structure versus Model Implementation

Hydrostratigraphic Unit	Originally Proposed Model Layers	Current Model Layering Approach	Geologic Period	Hydrogeologic Characteristics
Quaternary Valley Fill Deposits	1	1	Cenozoic	Limited Area of Saturation in the San Mateo Creek Basin (Weston Solutions, 2018)
Point Lookout Sandstone	2	2	Cretaceous	Limited Water Bearing Unit (T varies from 0.4 ft ² /d to 236 ft ² /d) (Stone et al., 1983; Kemodle, 1996)
Crevasse Canyon Formation	3		Cretaceous	Interbedded Coal and Sandstone; Limited Water Bearing Unit. T is approximately 50 ft ² /d (Stone et al., 1983)
Mulatto Tongue	4		Cretaceous	Aquitard (Walvoord et al., 1998)
Gallup Sandstone	5		Cretaceous	Aquifer (Kemodle, 1996)
Mancos Shale	6		Cretaceous	Aquitard (Walvoord et al., 1998)
Dakota Sandstone	7		Cretaceous	Aquifer and Uranium Bearing (Kemodle, 1996)
Morrison Formation	8		Jurassic	Aquifer (primary uranium ore bearing unit) (Kemodle, 1996)
San Rafael (i.e., Entrada)	9		Jurassic	Limited Water Bearing Unit near Outcrops (Kemodle, 1996)

Table 3-1 - Initially Proposed Layer Structure versus Model Implementation

Hydrostratigraphic Unit	Originally Proposed Model Layers	Current Model Layering Approach	Geologic Period	Hydrogeologic Characteristics
Chinle Shale	10	3	Triassic	Aquitard (HDR, 2016)
Upper Chinle Water Bearing Unit	11	4	Triassic	Water Bearing (HDR, 2016)
Chinle Shale	12	5	Triassic	Aquitard (HDR, 2016)
Middle Chinle Water Bearing Unit	13	6	Triassic	Water Bearing (HDR, 2016)
Chinle Shale	14	7	Triassic	Aquitard (HDR, 2016)
Lower Chinle Water Bearing Unit	15	8	Triassic	Water Bearing (HDR, 2016)
Chinle Shale	16	9	Triassic	Aquitard (HDR, 2016)
San Andres Limestone/	17	10	Permian	Primary Aquifer (Stone et al., 1983)
Glorieta Sandstone (SAG)	18		Permian	

3.4 Flow Model Boundary Conditions

Model boundary conditions provide a mechanism to add flow into the groundwater system (such as recharge, well injection, or upgradient inflow) and to allow for flow out of the system (such as well pumping or as downgradient outflow). Groundwater flow can also be affected by no-flow boundaries and fault structures that restrict flow. Boundary conditions developed for the current model construct are described below and were only minimally adjusted during model testing and calibration.

3.4.1 Groundwater Recharge

Background recharge from seasonal precipitation is applied to the highest active model layer through the MODFLOW Recharge (RCH) package. Specifically, if upper model layers are simulated as dry, MODFLOW passes recharge vertically downward into the model and recharge is then applied to an elevation associated with the simulated water table.

Currently, groundwater recharge is primarily simulated in the model based on spatial precipitation data obtained from the Parameter-Elevation Regressions on Independent Slopes Model (PRISM) (PRISM Group 2004). The PRISM method interpolates a database of climate records onto a spatial grid covering the coterminous United States (Daly et al., 2008). PRISM calculates a climate-elevation regression for each gridded spatial location based on data from nearby climate stations where long-term records are available, and on a digital elevation model (DEM). Factors considered in the regression used for interpolation of precipitation include location, elevation, coastal proximity, topographic facet orientation, vertical atmospheric layer, topographic position, and orographic effectiveness of the terrain. PRISM precipitation data for 2016 were obtained for the PRISM 4-kilometer stable data grid and further spatially interpolated using GIS-based methods. The preliminary model does not vary basin-wide areal recharge transiently to focus on simulating the primary transient hydrologic stresses of the Site remedial systems, but subsequent versions of the model may include transient variation of groundwater recharge.

The GIS-interpolated precipitation dataset was initially scaled to an estimate of groundwater recharge as 5% of total precipitation through most of the SMC Basin based on estimates included in previous studies performed across the southwest. Specifically, this scaling approach is consistent with other numerical modeling efforts for the region where, on average, a range of 2%-6% of precipitation has been used as an estimate of recharge to groundwater (Scanlon et al. 2006). At southern edge of the model domain where the San Andres-Glorieta aquifer materials outcrop on the flanks of the Zuni Mountains was initially scaled to 25% of total precipitation to account for infiltration of snowmelt and runoff from the Zuni Mountains. During the model

calibration process, these percentages of total precipitation simulated as groundwater recharge were adjusted to be 4% for areas in the basin covered by alluvium, 1% for areas in the basin with relatively permeable bedrock at the surface (i.e., sandstone), 0% for areas in the basin with relatively impermeable bedrock at the surface (i.e., mudstones), and 30% for the SAG aquifer outcrops at the southern edge of the model domain. These recharge rates, as currently represented in the model, are provided on Figure 3-6.

Seepage from the LTP represents an important source of both recharge and chemical mass loading to the local groundwater system. A separate seepage model (the reformulated mixing model [RMM]) has been developed to assess long-term changes in both seepage flow rates and constituent mass loading (HDR, 2016, Appendix G). Assessments of past LTP seepage rates, along with predictions of future seepage rates, have been developed based on vadose modeling using the VADOSE/W code. Development, calibration, and application of the VADOSE/W seepage model is described in HDR, 2016, Appendix G. Seepage estimates developed from that model are used in the current version of the GRP model to simulate flow from the LTP into the local groundwater system and are shown in Figure 3-6 as a location of high recharge beneath the LTP. Updated LTP seepage rate estimations associated with future revisions to the RMM may be incorporated into subsequent versions of the GRP model.

3.4.2 Well Pumping and Injection

Ongoing remediation of the GRP Site includes both injection and groundwater extraction to create and maintain a hydraulic barrier to control potential groundwater migration away from the LTP footprint (HDR, 2016). The general groundwater restoration sequence utilizes injection of San Andres aquifer fresh water, treated water from the RO and zeolite remediation systems around the impacted area with simultaneous collection to contain impacted water. The injection of unimpacted water serves the primary purpose of enhancing and expanding a hydraulic barrier to further limit uranium/COC migration and directing impacted groundwater to collection wells. Comprehensive details on the GRP Site remediation system pumping and injection program, including well locations, can be found in HDR (2016) and HMC and HE (2018).

Volumes, rates, and locations of injection and extraction have varied over time to optimize system performance and maintenance of the hydraulic barrier is re-assessed and modified on roughly an annual basis. In addition, groundwater extraction volumes from wells are measured on an aggregate basis for the alluvial aquifer, Upper and Middle Chinle aquifers, and off-site areas, respectively (HMC and HE, 2018). Similarly, injection rates within specific aquifer units and areas of the GRP Site are also measured collectively and not for individual wells. (HMC and HE, 2018).

Therefore, past pumping and injection rates at specific locations were approximated for years 2013 through 2016 and organized into a database by Hydro-Engineering, LLC., (personal communication, Hydro-Engineering, 2017). These rates were then simulated in the GRP Model using the MODFLOW Well (WEL) package. As discussed previously, only projections of 2017 pumping/injection rates were available for most of the time that the model was being developed and calibrated. Estimates of actual system operations for 2017 (rather than projections) recently became available and were subsequently included in the groundwater model; however, the stress period interval remains as a single year for 2017.

At the time of preliminary model development, regional pumping data for the SAG associated with municipal, commercial, irrigation, domestic, and livestock uses were not available. Specifically, there is known pumping in the SAG south and west of the GRP by Tri-State Power, Murray Acres Community Association and Village of Milan and regional pumping from the SAG aquifer has gradually drawn down water levels in the aquifer over time (DOE, 2014). Thus, simulated groundwater withdrawals are currently approximated in the SAG aquifer using a set of 12 wells pumping at an assumed constant rate of 1,000 gpm in order to help match observed and calibrated groundwater elevations. As part of future work, if reliable historical SAG pumping records can be obtained from sources such as the New Mexico State Engineer Office, the estimated pumping rates and locations may be replaced with known volumes.

3.4.3 Surface Water

In general, streams in the SMC Basin are ephemeral and consist of San Mateo Creek, the Arroyo del Puerto, and the Lobo Canyon drainage (Figure 1-1). Surface flows in these creeks and drainages are generally non-existent and only occur for short periods of time in response to extreme snowmelt and/or summer thunderstorm events. In the upper parts of the SMC Basin and Lobo Canyon, on the west side of Mount Taylor, perennial flow occurs at San Mateo Springs, an unnamed tributary of San Mateo Creek, and an unnamed tributary of the Lobo Canyon drainage. Further up-valley from the Routes 605/509 intersection leading to the village of San Mateo, San Mateo Creek may be more perennial. Surface water flows for these streams are not currently simulated but may be added to the model when hydrostratigraphy associated with the upper SMC Basin is incorporated into the groundwater model.

South of the SMC basin and the GRP Site, the Rio San Jose is a larger surface water feature that is currently simulated in the model using the stream package. The stream package provides the model with a defined head reference in Layer 1 that helps to improve overall solution stability and maintains regional alluvial groundwater flow directions toward the southeast in this portion of the domain. The Rio San Jose is the only surface water feature currently represented in the model domain (Figure 3-7).

3.4.4 Horizontal Flow Barrier – San Mateo Fault

The geologic model developed in Leapfrog introduces explicit representation of offsets between principal hydrostratigraphic units at both the regional scale and beneath the GRP, which allows contacts of differing hydraulic properties in the groundwater flow and transport simulations. However, during calibration of the groundwater flow and transport model, it was determined that overall model calibration improved if the San Mateo Fault was represented as a flow barrier. In the model north of the GRP, the HFB bifurcates to represent both the east and west splays of the San Mateo Fault (Figure 3-8 through Figure 3-16). The Leapfrog geologic model used the geometric representations of the San Mateo Fault splays at the site from the previous site-scale geologic model (including the interpreted fault dips) and extended the splays to the north (HMC 2012). To represent the San Mateo Fault as a continuous barrier to flow in the groundwater flow and transport model, the flow barriers were placed vertically along cell faces following the lateral centerline of the fault splays with their interpreted dips inherited from the previous site-scale geologic model. A vertical representation of the fault is necessary to avoid simulating vertical bypass of groundwater flow between model layers where using flow barriers located based on the dips of the faults would be offset laterally. To limit simulated horizontal hydraulic flow across the faults, a conductivity value of 0.1243 feet/day (ft/d) is assigned in all HFB package locations. The flow barrier is applied only in Layers 2 through 9 where layer thicknesses are greater than 1 ft.

3.4.5 General Head Boundaries – Regional Aquifer Systems Inflow and Outflow

General head boundaries (GHBs) are used to simulate regional groundwater flows for major aquifer units in the SMC Basin. General head boundaries for the Mesozoic bedrock above the Chinle Group in model layer 2 were developed using published groundwater-level contour maps for the Entrada Complex (also known as the San Rafael Group) and Morrison Formation (Brod and Stone, 1981; Frenzel and Lyford, 1982; Stone et al. 1983), as presented and discussed in the Work Plan (HMC 2018a). These general head boundaries allow simulated groundwater in model layer 2 (bedrock above the Chinle group) to flow to the northeast in the northern portion of the SMC Basin and to the east in the southeastern portion of the SMC Basin, as depicted on previously published groundwater level maps (Figure 3-8).

Little regional flow information exists for the Chinle Group because it represents a regional aquitard even if the water-bearing units observed in the vicinity of the GRP site are important to local-scale groundwater flow at the site. As such, the GHBs developed for the model layers representing the Chinle Group (Figures 3-9 through 3-15) are based on the overlying and underlying units and primarily provide model solution stability rather than simulation of the uncertain regional groundwater flow in the Chinle Group. The uppermost Chinle

shale (model layer 3; Figure 3-9) general head boundaries were developed using the general head boundaries of the bedrock above the Chinle Group (model layer 2; Figure 3-8). The lowermost Chinle shale (model layer 9; Figure 3-15) general head boundaries were developed using the general head boundaries of the SAG (model layer 10; Figure 3-16). The general head boundaries in model layers 3 and 9 provide a mechanism for the model to simulate observed downward vertical gradients across the Chinle Group regional aquitard. The remaining general head boundaries in the Chinle Group are only placed in the water-bearing units (model layers 4, 6, and 8) on the eastern side of the SMC Basin and are intended to provide model solution stability (Figures 3-10, 3-12, and 3-14).

Similarly, GHBs for the San Andres/Glorieta (SAG) aquifer in model layer 10 were developed using a published groundwater-level contour map for the SAG aquifer (Baldwin and Anderholm, 1992; HMC, 2018a) and boundary condition locations are provided in Figure 3-16.

3.5 Aquifer Physical Properties

Original zonation of model hydraulic parameterization was based on the Leapfrog 3-D geologic model, developed from geologic mapping, and borehole data from both the GRP site and SMC Basin. Initial parameterization values for the different hydrostratigraphic units relied upon published literature values for each material type including Fetter (2001) and Schwartz and Zhang (2003). Input hydraulic parameter values (primarily hydraulic conductivity) were then adjusted within typically observed ranges to better match observed groundwater-level data and interpreted flow directions in accordance with standard manual calibration practices. Table 3-2, provided below, shows the hydraulic conductivity and storage values for each hydrostratigraphic unit in the preliminarily calibrated flow model.

Table 3-2 – Hydraulic Parameterization Summary

Model Layer Number	Hydrostratigraphy	Preliminary GRP Groundwater Model Hydraulic Parameter Values		
		Horizontal Hydraulic Conductivity (ft/d)	Specific Yield (–)	Specific Storage (1/ft)
1	Alluvium	2.0 - 200	0.1	0.0001
2	Bedrock above the Chinle Group	0.04	0.01	0.00001
3	Chinle Shale	0.0006	0.005	0.0000001
4	Upper Chinle Aquifer	0.10 - 10	0.01	0.00001
5	Chinle Shale	0.001	0.005	0.0000001
6	Middle Chinle Aquifer	1.0 - 10	0.01	0.00001
7	Chinle Shale	0.001	0.005	0.0000001
8	Lower Chinle Aquifer	1.0 - 10	0.01	0.00001
9	Chinle Shale	0.0009	0.01	0.00001
10	SAG	20 - 500	0.2	0.0001

Figures 3-10 through 3-19 provide the hydraulic conductivity values associated with each respective hydrostratigraphic model layer and pixelated coloration is used to show areas of nominal layer thickness, as described previously. Zonation of parameter values within a given layer were used to improve the match between simulated groundwater elevations, flow directions, and constituent transport with observed data and is a standard calibration technique used in numerical modeling (Anderson et al. 2015). Where hydraulic

conductivity values associated with layer hydrostratigraphy are shown in these figures, the constant specific yield and specific storage shown in Table 3-2 are applied in the model. For example, in Figure 3-10, all areas of Alluvium in Layer 1 are assigned a specific yield of 0.1 and specific storage of 0.0001 ft⁻¹. Similarly, where Figure 3-11 shows zonation associated with the bedrock above the Chinle Group, this area is assigned specific yield equal to 0.01 and specific storage of 0.00001 ft⁻¹.

Section 4: Flow Model Calibration

Model calibration for the 2013-2017 period focused on four primary areas:

- Reasonable simulation of wetting and drying of alluvium associated with GRP remediation activities
- Simulation of observed groundwater elevations especially for the alluvial aquifer in the vicinity of the GRP
- Simulation of observed groundwater flow directions in the GRP area
- Development of a groundwater flow solution that allowed calibration to observed uranium and molybdenum concentrations

Model parameters, including aquifer physical parameters and application of PRISM recharge (this did not include LTP seepage) were adjusted to obtain agreement with observed conditions. The final calibration represents a balance between the calibration objectives, as certain parameter modifications may have improved the model's ability to simulate one condition (such as improved simulation of groundwater elevations) while degrading the model's match in other areas (such as degraded matches to observed constituent concentrations). The current set of model parameters achieves a good balance between all model calibration objectives but will likely change as additional updates are made to the model.

The existing current version of the GRP model was manually calibrated such that simulated heads generally match observed groundwater elevations. The head target dataset consists of 45 locations in the alluvium (Layer 1; 330 observations), 3 locations in the Upper Chinle aquifer (Layer 4; 37 observations), 3 locations in the Middle Chinle aquifer (Layer 6; 37 observations), 1 Lower Chinle aquifer location (Layer 8; 7 observations), and 10 San Andres/Glorieta locations (Layer 10, 45 observations). Figures 4-1 through 4-5 provide groundwater flow targets used for calibration.

Analysis of how well the model simulates observed conditions is based on statistics related to model residuals (the difference between simulated and observed groundwater levels). Standard calibration statistics include the average residual, absolute average residual, root mean squared error (RMSE, which gives greater weight to larger residuals), and the scaled RMSE (RMSE divided by the total change in measured head, a measure of how well the model simulates groundwater flow gradients). Table 4-1 provides a summary of these statistics for the overall model and for only the alluvial aquifer, since the calibration for the alluvium is especially critical for estimation of remediation timeframes at the GRP.

It is important to note that an industry-defined statistical range that quantifies a well-calibrated model does not exist, since modeling by necessity requires subjectivity and the acceptability of a calibration is directly dependent on the modeling objective (Anderson et al., 2015). In general terms, however, regional models typically strive for percentage error metrics (e.g., scaled RMSE) of less than 10% whereas local scale models attempt for scaled statistics less than 5%. In the case of the GRP model, when all layers are included, the model has regional characteristics and thus a scaled RMSE of 6.22% is acceptable. The low residual mean also indicates that on average, there is little bias to the solution and the absolute residual mean suggests that the groundwater flow solution is typically within 8.76 feet of the observed value.

For the alluvial aquifer, alone, most of the targets are in the vicinity of the GRP so the calibration process aimed for minimizing both the residual mean and the absolute residual mean with scaled statistic values of

less than 5%. In the current model version, the residual mean indicates that simulated alluvial heads are, on average, slightly high (negative values indicate over-estimation) while the absolute residual mean shows that the solution is typically within 5.86 feet of observed alluvial groundwater elevations. Scaled statistics are well below 5% and range from 3.21% to 4.33% for Layer 1.

Table 4-1 – Bulk Simulated Groundwater Elevation Calibration Statistics

Statistic	All Layers	Model Layer 1 (Alluvial Aquifer)
Residual Mean (feet)	-0.47	-1.79
Absolute Residual Mean (feet)	8.76	5.86
Sum of Square Residuals (feet ²)	76,140	20,515
Root Mean Squared RMS Error (feet)	12.92	7.88
Minimum Residual (feet)	-43.67	-22.66
Maximum Residual (feet)	61.54	61.54
Number of Observations	456	330
Range in Observations (feet)	207.62	182.23
Scaled RMS error (%)	6.22	4.21
Scaled Absolute Mean (%)	4.22	3.21
Scaled Residual Standard Deviation (%)	6.23	4.33

Figure 4-1 presents a scatter plot comparing simulated and observed groundwater elevations. For all layers except Layer 4, simulated groundwater elevations relative to target values generally fall near the 1:1 line, indicative of good calibration. However, there is a cluster of observations in the Upper Chinle aquifer associated with two target wells (i.e., 929 and 931) where observed values are higher than what the model currently simulates. Improving model calibration for these two targets may be part of future efforts.

Simulated contours for the alluvial aquifer are provided in Figures 4-2 and 4-3. The simulated contours for both 2015 and 2017 approximate both observed groundwater elevations and key groundwater flow directions reflected in the observed data. This includes:

- Southerly groundwater flow from the upgradient portions of the SMC Basin toward the GRP
- Westerly groundwater flow directions west of the NRC License Boundary
- Southerly groundwater flow south of the Small Tailings Pile
- Divergent groundwater flow around the bedrock high located southwest of the GRP

Hydrographs for all simulated targets are provided in Appendix A and all groundwater elevation target values are provided in table format as Appendix B.

Given the overall objectives of the current version to simulate remediation timeframes for the GRP, the model is considered sufficiently calibrated to observed water levels and the general hydraulic gradients. Groundwater levels are simulated to within approximately 5.86 ft on average in the alluvial aquifer, with simulated levels being slightly higher than those observed. The overall model scaled RMSE is 6.2% whereas the alluvial aquifer scaled RMSE is 4.2%, representing good calibration to the regional hydraulic gradient and observed alluvial groundwater elevations.

Section 5: Transport Model

For contaminant transport assessment at uranium mill tailings sites, regulatory guidance stipulates that geochemical conditions be sufficiently characterized to: (1) estimate the source term, (2) characterize the subsurface geochemical properties, and (3) identify contaminant attenuation mechanisms (USNRC, 2003a). Consequently, HMC initiated a characterization study in 2018 to assess geochemical conditions within the tailings and the alluvial groundwater system. The objectives were to characterize the solid-phase geochemistry of tailings and alluvium, together with geochemical conditions in the tailings solution and alluvial groundwater, to better understand the factors controlling transport of three primary COCs (uranium, molybdenum, selenium). An interim report for this ongoing characterization study was prepared in November 2018 (WME, 2018), and a draft site conceptual geochemical model (CGM) is under development which incorporates historic information and preliminary data from the recently implemented characterization study. The numerical parameters quantifying the extent of uranium and molybdenum attenuation in the current groundwater flow model were established using the CGM in conjunction with site-specific geochemical data as described in this section.

5.1 Tailings Geochemistry

The Homestake uranium mill utilized an alkaline circuit to process sandstone ore (80 to 85% of the mill feed) and limestone ore (15 to 20% of the mill feed) sourced from underground mines in the Ambrosia Lake subdistrict (Skiff and Turner, 1981). Uranium mineralization occurred as coffinite $[\text{U}(\text{SiO}_4)_{1-x}(\text{OH})_{4x}]$, uraninite (UO_2), tyuyamunite $[\text{Ca}(\text{UO}_2)(\text{VO}_4)_2 \cdot (5-8)\text{H}_2\text{O}]$, and carnotite ($\text{K}_2\text{O} \cdot 2\text{UO}_3 \cdot \text{V}_2\text{O}_5$) associated with carbonaceous material and sulfide minerals containing molybdenum and selenium. The tailings slurry consisted of a high-pH (≈ 10) sodium-sulfate water, with elevated concentrations of total dissolved solids (TDS), uranium, molybdenum, and indicator constituents (chloride and sulfate) (Table 5-1). Redox conditions are important in controlling the solubility and behavior of COCs in the tailings and were evaluated by assessing dissolved oxygen (DO) content and measured redox potential (Eh). Because field Eh measurements are often unstable unless the system is completely anoxic (devoid of DO) and dominated by iron, sulfur, and manganese (Langmuir, 1997), the characterization study in 2018 included analysis for additional redox couples to assess the redox status of the groundwater, including iron ($\text{Fe}^{2+}/\text{Fe}^{3+}$), nitrogen (NH_4/NO_3), and sulfur ($\text{H}_2\text{S}/\text{SO}_4$). This evaluation indicated that Eh values computed from the NH_4/NO_3 redox couple provides the closest match to field-measured Eh values (Figure 5-1). The low DO concentrations in some tailings wells is consistent with the consumption of DO by organic decay, producing localized reducing conditions. The redox classification scheme developed for groundwaters (Langmuir, 1997) indicates the tailings can be classified as ranging from "oxic" to "suboxic", although the presence of measurable sulfide (H_2S) concentrations suggests the existence of some "anoxic sulfidic" zones.

Tailings speciation calculations were subsequently conducted with the geochemical model PHREEQC (Parkhurst and Appelo, 2013) using Eh calculated from the NH_4/NO_3 couple to define redox conditions (WME, 2018). The results indicate that dissolved uranium and molybdenum occur primarily in their oxidized forms $[\text{U}(\text{VI}), \text{Mo}(\text{VI})]$, while selenium is present as both $\text{Se}(\text{VI})$ and $\text{Se}(\text{IV})$. Molybdenum is predicted to exist primarily as the molybdate ion (MoO_4^{2-}), uranium as the uranyl tetracarbonate species ($\text{UO}_2(\text{CO}_3)_3^{4-}$), and selenium as selenite (SeO_3^-) with only minor selenate (SeO_4^{2-}). Calculated saturation index (SI) values suggest there are no discrete uranium, molybdenum, or selenium minerals controlling the overall concentrations

Table 5-1 – Chemical Characteristics of Homestake Mill Tailings Solution

Constituent	Tailings Solution ¹ (HE, 1983)				Tailings Sump (NMHED, 1980)			Average	
	11-16-78	11-6-79	9-23-81	10-28-82	10-26-77	11-16-78	11-6-79	Solution	Sump
Calcium	<0.01	<0.01	135	35	nr ²	10.0	60.0	85	35
Magnesium	nr	<0.1	30.0	nr	nr	nr	813	30.0	813
Sodium	10,000	10,000	9,800	9,080	6,141	8,464	9,292	9,720	7,966
Potassium	0.58	nr	nr	450	nr	31.2	35.1	225	33.2
Bicarbonate	3,280	nr	1,850	2,480	nr	nr	2,388	2,537	2,388
Carbonate	nr	nr	6,450	nr	nr	nr	nr	6,450	-----
Sulfate	8,100	8,420	15,700	12,800	5,532	8,346	8,412	11,255	7,430
Chloride	624	1,070	2,340	1,870	793.2	1,014	1,418	1,476	1,075
TDS	nr	nr	43,300	31,400	17,035	20,710	25,400	37,350	21,048
pH	nr	10.1	10.3	9.9	10.12	nr	10.32	10.1	10.22
Nitrate-N	13.8	11.0	8.2	nr	nr	22.42	10.72	11.0	16.6
Ammonia-N	<1.0	nr	nr	nr	11.2	13.9	17.8	<1.0	14.3
Aluminum	nr	nr	<1.0	nr	nr	nr	<0.25	<1.0	<0.25
Arsenic	0.18	nr	0.07	0.08	2.86	7.19	5.02	0.11	5.02
Barium	<1.0	nr	<1.0	<1.0	<0.10	0.051	<0.10	<1.0	0.051
Cadmium	<0.01	nr	<0.01	<0.01	nr	0.0277	0.001	<0.01	0.014
Lead	<0.01	nr	<0.01	0.01	nr	<0.005	0.007	<0.01	0.007
Molybdenum	80.5	74.8	105	94.0	72.0	105.2	104.5	88.6	93.9
Selenium	26.4	14.7	35.5	24.8	51.18	31.16	27.88	25.4 (0.92) ^B	36.7
Uranium	54.3	47.3	21.0	24.7	44.0	52.8	4.17	36.8 (150) ^B	33.7
Vanadium	16.9	nr	9.23	4.23	nr	13.6	1.18	10.1 (6.8) ^B	7.39
Zinc	14.8	nr	6.62	<1.0	nr	<0.10	<0.25	10.7	-----
Gross Alpha (pCi/L)	nr	nr	nr	nr	nr	10,000 ±1,000	3,400±400	29,000	6,700
²²⁶ Radium (pCi/L)	31.9	23.5	88.4	80.3	58 ±4	90 ±1	56 ±17	56.0 (52) ^B	68

Table 5-1 – Chemical Characteristics of Homestake Mill Tailings Solution

Constituent	Tailings Solution ¹ (HE, 1983)				Tailings Sump (NMHED, 1980)			Average	
	11-16-78	11-6-79	9-23-81	10-28-82	10-26-77	11-16-78	11-6-79	Solution	Sump
²¹⁰ Pb (pCi/L)	nr	nr	nr	nr	49 ±8	nr	nr	-----	49 ±8
²³⁰ Th (pCi/L)	nr	0.036	0.151	nr	nr	nr	nr	0.094	0.094

¹All concentrations are total (unfiltered) and expressed as mg/L except where noted. ²nr = not reported.³Average value reported by USEPA, 1975.

of uranium or molybdenum in the tailings. The tailings are undersaturated with respect to the common reduced uranium(IV) minerals of low solubility [uraninite, $\text{UO}_2(\text{c})$; amorphous uranium oxide, $\text{UO}_2(\text{am})$], and the oxidized uranium(VI) minerals of high solubility (carnotite, tyuyamunite, uranium phosphate). The tailings are also undersaturated with the common molybdenum and selenium minerals, such as calcium molybdate (CaMoO_4) and elemental selenium [$\text{Se}(\text{am})$].

The tailings mineralogy is dominated by quartz, feldspar, and clays, with lesser amounts of calcite, pyrite, and iron oxides. Although tailings solutions were calculated to be undersaturated with respect to selenium and uranium minerals, electron microscopy revealed selenium in association with iron on the surface of pyrite and as elemental selenium mineral inclusions. Uranium was associated with calcium and vanadium, consistent with an oxidized mineralogy (tyuyamunite, carnotite), and selective chemical extraction suggests uranium may be associated with carbonates, organic matter, and iron oxides. No solid-phase forms of molybdenum were identified through microscopy; however selective chemical extraction indicates the majority of molybdenum in the tailings is either water soluble or occurs in an unidentified residual (stable) form, with lesser amounts extracted from the exchangeable and organic/sulfide phases (WME, 2018). Static testing using acid-base accounting showed the tailings contain an excess acid neutralizing capacity, and kinetic testing using humidity cells did not indicate any significant release of acidity, iron, sulfate, uranium, selenium, or molybdenum. At present, the tailings solids do not appear to represent a significant residual source term upon prolonged weathering, relative to existing elevated concentrations of uranium and molybdenum in the existing tailings seepage.

5.2 Alluvial Groundwater Geochemistry

Alluvial groundwater in the vicinity of the LTP is a sodium-sulfate type water with elevated pH due to tailings influence, but becomes more calcium-sulfate dominated, consistent with background conditions, with increasing distance from the LTP. The alluvial aquifer is more oxidizing compared to the tailings, with measurable DO up to 6 mg/L, and very low to non-detectable concentrations of ferrous iron (Fe^{2+}), ammonia-nitrogen ($\text{NH}_3\text{-N}$), and hydrogen sulfide (H_2S). Poor agreement between the measured Eh and that calculated from the DO content (Figure 5-1) indicates a general lack of redox equilibrium, and the DO content was therefore used to control redox in subsequent calculations. Redox conditions are classified as oxic based on DO concentrations, and the dissolved uranium, molybdenum, and selenium are predicted to occur primarily in their oxidized forms [$\text{U}(\text{VI})$, $\text{Mo}(\text{VI})$, $\text{Se}(\text{VI})$]. PHREEQC was used to predict speciation: molybdenum in the alluvial groundwater exists primarily as the molybdate ion (MoO_4^{2-}), uranium speciation is dominated by the uranium(VI)-calcium complexes ($\text{CaUO}_2(\text{CO}_3)_3^{2-}$, $\text{Ca}_2\text{UO}_2(\text{CO}_3)_3$), and selenium is mainly present as selenate (SeO_4^{2-}). The SI values for the reduced uranium(IV) minerals (amorphous and crystalline UO_2) indicate a high degree of undersaturation due to the low calculated proportion of reduced uranium(IV). Undersaturation was also calculated for the common oxidized uranium(VI) minerals (e.g., carnotite or tyuyamunite), elemental selenium, ferroselite (FeSe_2), and calcium molybdate. The alluvial aquifer is in equilibrium with calcite, oversaturated with respect to ferrihydrite, and undersaturated with respect to pyrite.

Nine alluvium samples were collected in 2018 mid-way through the saturated zone from locations upgradient and downgradient of the LTP, various numbers of which were analyzed for bulk mineralogical composition and selected chemical properties (WME, 2018). The alluvial aquifer mineralogy is dominated by quartz, feldspar, calcite (Table 5-2). Only minor clay was identified (2 to 15% kaolinite, smectite, illite) and the resulting cation exchange capacity (CEC) values were low (2.9 to 7.7 cmol₊/kg) (Table 5-2). Pyrite was below detection in all samples (<1%) using X-Ray Diffraction (XRD) and the sulfide-S content was <0.01% from sulfur fractionation testing. Natural weathering of the alluvium in a predominantly oxidizing environment limits the preservation of iron sulfides, however these have been shown to be present in finer grained silts and clays associated with the alluvial system (HMC, 2018c). Weathering of pyrite and other iron-bearing primary minerals generates iron oxides as stable weathering products under oxidizing conditions.

Table 5-2 – XRD Mineralogy and Chemical Results (Percent by Weight Unless Indicated) for Alluvium Samples (WME, 2018)

Sample ID	WME-8 @110'	WME-8 @121	WME-11	WME-14	WME-15	WME-16	WME-17	Mean
Location	Perched alluvium below LTP	Perched alluvium below LTP	North of LTP	South of LTP	South of LTP	Adjacent to LTP	Adjacent to LTP	
Quartz	72	74	73	40	72	77	77	69
K-Feldspar	10	8	7	5	7	8	8	7.6
Plagioclase	7	7	7	6	5	7	9	6.9
Calcite	4	6	9	21	11	6	4	8.7
Smectite	4	3	1	4	3	1	1	2.4
Illite	1	1	1	6	1	<1	<1	2.0
Kaolinite	2	1	1	5	1	1	1	1.7
Pyrite	<1	<1	<1	<1	<1	<1	<1	<1
Sulfide-Sulfur	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Total Iron	0.54	1.18	3.57	1.51	1.27	0.86	nm	1.37 ¹
Total Iron ²	Sands with gravel and/or silt							0.529
	Overall average of sands, silts, clays							1.089
Extractable Iron	0.092	0.051	0.0347	0.0228	0.0420	0.0485	nm	0.050 ¹
CEC (cmol+ kg ⁻¹)	4.1	4.2	2.9	7.7	4.2	3.1	6.1	4.9 ¹

¹ Mean value includes two additional samples not analyzed for XRD mineralogy.² Mean value from HMC, 2018.

Iron oxides are considered the most important adsorbents for trace elements in nature due to their high capacity for adsorption, coupled with their tendency to be finely dispersed and to occur as mineral coatings (Dzombak and Morel, 1990; Langmuir, 1997). Iron oxides were not apparent because the crystalline forms (e.g., hematite) were below the XRD detection limit (1 to 3%) and/or a significant fraction of the iron oxide is non-crystalline (amorphous iron hydroxide, ferrihydrite). Chemical analysis showed the total iron content of the alluvium samples ranged from 0.54 to 3.57% with an average of 1.37%. This value is consistent with the average of five samples (1.09%) reported by HMC (2018c) containing a mixture of sands, silts, and clays and where hematite was identified with XRD in two of the samples (1%). Selective chemical extraction for the WME (2018) samples indicates that a small proportion of the iron exists as amorphous iron hydroxide with a content averaging 0.05% as iron (Table 5-2, Figure 5-2).

No discrete mineralogical forms of uranium or molybdenum could be identified through direct examination of the alluvium samples. However, selective chemical extraction indicated that a fraction of the total uranium was associated with iron oxides in both tailings-influenced and non-impacted alluvium samples. While chemical extraction methods are not completely selective, they are useful in understanding general associations and for comparison between samples. Alluvium samples influenced by tailings (adjacent, perched, and vadose) contained relatively higher fractions of soluble, exchangeable, and carbonate-bound uranium, in addition to iron oxide bound, compared to the remaining non-impacted samples (Figure 5-3). The samples contain low CEC (Table 5-2) and uranium, sourced from LTP seepage/groundwater, is not expected to be strongly retained by clays under site conditions (Section 5.3). Therefore, the uranium associated with the exchangeable fraction may have been extracted from iron oxide surfaces by the high ionic strength of the exchangeable solution (1 M MgCl_2). Molybdenum also adsorbs to iron oxide minerals but was found to exist in a predominantly residual form in all samples (WME, 2018). The paucity of molybdenum associated with iron oxides in the selective extractions also suggests some molybdenum associated with iron oxides may have been extracted in the exchangeable step during chemical extraction.

5.3 Conceptual Geochemical Model

In the current CGM, an active source term is contained within a dissipating mound of tailings water where the rates of seepage will continue to decrease over time (Figure 5-4). The sodium-sulfate tailings seepage contains elevated pH, TDS, and COC concentrations, with redox conditions ranging from oxic to suboxic. Uranium exists primarily as oxidized U(VI) complexed with carbonate ($\text{UO}_2(\text{CO}_3)_2^{2-}$) while molybdenum is mainly present as the oxidized molybdate (MoO_4^{2-}) ion. Dissolved selenium in the tailings is predicted to occur as both the oxidized [Se(VI)] selenate (SeO_4^{2-}) ion and the reduced [Se(IV)] selenite (SeO_3^{2-}) species. As tailings seepage migrates into the underlying alluvial aquifer, it becomes partially diluted as it mixes with alluvial groundwater from upgradient. As the tailings-influenced groundwater moves downgradient, the concentrations of conservative indicator constituents (chloride, sulfate) are controlled by dilution and dispersion. The dissolved uranium becomes dominated by the uranyl-calcium complexes ($\text{CaUO}_2(\text{CO}_3)_3^{2-}$, $\text{Ca}_2\text{UO}_2(\text{CO}_3)_3$) and selenate becomes the main form of selenium upon mixing with the more oxidizing calcium-sulfate type alluvial groundwater. Molybdenum continues to migrate as the free molybdate ion.

Potential attenuation mechanisms for the COCs in the alluvial aquifer include mineral precipitation, adsorption by various clay minerals, and adsorption by amorphous iron hydroxide (ferrihydrite). Direct precipitation of COCs is not considered to be an important attenuation mechanism in the alluvial aquifer due to the extent of undersaturation with respect to the oxidized mineral forms (e.g., carnotite, calcium molybdate, metal selenates). However, HMC (2018c) has recognized the presence of reduced microenvironments in the alluvial aquifer which could produce locally-reducing conditions. Selenium is more easily reduced relative to uranium and molybdenum, and thus could also potentially migrate as selenite or precipitate as elemental selenium in these localized zones (Figure 5-4). The relative importance of the two remaining attenuation mechanisms (adsorption to clays or ferrihydrite) focuses on the two COCs (uranium and molybdenum) whose modeled transport results are presented in this report.

The affinity for adsorption of COCs to minerals is controlled by the forms of dissolved uranium and molybdenum in the groundwater, and the surface charge of the mineral, both of which are pH-dependent. Uranium is mainly present as negatively-charged calcium- and carbonate-complexes under Site pH conditions, and would only exist as positively-charged species (UO_2OH^+ , UO_2^{2+}) below pH of 6 (Figure 5-5a). Similarly, molybdenum occurs primarily as the negatively-charged MoO_4^{2-} ion (Figure 5-5b). Clay minerals are negatively-charged above pH of 5 (Appelo and Postma, 2013), producing a swarm of positively-charged cations (Na^+ , Ca^{2+}) at their surface, where the concentrations of negatively-charged anions are the lowest. A diffuse layer of ions extends from the surface into the solution, with cations at higher and anions at lower concentrations than in the solution (Figure 5-6). Major cations (Na^+ , Ca^{2+}) are held rather weakly to the clays by electrostatic force, whereas metal oxyanions bond more strongly with oxygen on mineral surfaces. However, under Site conditions (pH >7), the anionic forms of uranium and molybdenum are essentially excluded from interacting with negatively-charged clays.

Alternatively, iron oxide surfaces will be neutral or positively-charged under most groundwater pH conditions (Appelo and Postma, 2013). Oxyanion adsorption involves both an electrostatic attraction and chemical bonding to the mineral surface, and adsorption of uranium and molybdenum by ferrihydrite is expected under Site conditions. In the CGM, adsorption by ferrihydrite [$\text{Fe}(\text{OH})_3$] is therefore considered to be the primary mechanism for partitioning of uranium and molybdenum in the alluvial aquifer (Figure 5-4). The extent of adsorption is not 100%, and will vary depending on the specific constituent and local geochemical conditions, such that a fraction of the uranium and molybdenum remains mobile. Due to its widespread nature, studies have shown ferrihydrite to exert more control on the attenuation of uranium compared to clays. For example, uranium adsorption data compiled by the USEPA (1999) suggests that soils containing higher percentages of iron oxides, mineral coatings, and/or clay minerals will exhibit higher adsorption capacities compared to soils solely dominated by quartz and feldspars (Figure 5-7). Some investigators have also shown that adsorption capacities for soils of mixed mineralogy are not necessarily correlated with clay content, but rather uranium appeared to be associated with mineral surface coatings of variable pH (consistent with ferrihydrite occurrence) (USEPA, 1999). Consequently, the use of surface complexation models (SCMs) utilizing the adsorptive behavior of uranium on ferrihydrite are almost universally used to model fate and transport of uranium in groundwater systems (e.g., Zhu et al., 2002; Curtis et al., 2009; Johnson et al., 2013; USNRC, 2003b; USNRC, 2006).

5.4 Transport Parameter Development

Incorporation of SCMs into geochemical reaction codes (e.g., PHREEQC, MINTEQA2) can be used to predict the adsorption behavior of metals and radionuclides as a function of key geochemical parameters (pH, carbonate concentration). The current state of knowledge regarding surface complexation constants for uranium adsorption onto iron oxides and the mechanistic understanding of the controlling reactions is probably as advanced as those for any other trace metal (USEPA, 2013). Three general models are commonly used to describe the adsorption of dissolved constituents onto mineral surfaces: (1) the distribution coefficient (K_d), (2) the Freundlich adsorption isotherm, and (3) the Langmuir adsorption isotherm (Langmuir, 1997). A geochemical surface complexation and mixing model (SCMM) was developed using site-specific data from which the Freundlich isotherm provided the best fit:

$$x/m = K_f C^{(1/n)} \quad [1]$$

where x/m is the weight of adsorbate per unit weight of adsorbent (mg/g), C is the equilibrium concentration of the adsorbate (mg/L), K_f is an empirical partition coefficient at equilibrium (L/g), and n is an empirical coefficient (INEEL, 2002).

5.4.1 Modeling Software and Database

The geochemical model PHREEQC (Parkhurst and Appelo, 2013) was used to develop the SCMM for describing uranium and molybdenum adsorption characteristics in the alluvial aquifer. PHREEQC is capable of performing a variety of geochemical calculations, such as solution speciation and saturation index calculations, solution mixing, mineral and gas equilibria, ion exchange simulations, and surface complexation reactions. The MINTEQv4.dat database developed by the USEPA (1998) was used because it contains an extensive compilation of thermodynamic data for uranium. A modified MINTEQv4.dat database has been created which contains additional thermodynamic data for the aqueous U(VI) alkaline-earth metal (Ca, Mg) complexes (Table 5-3), which have since been recognized as playing an important role in the environmental chemistry of uranium. For the surface complexation component of the model, a number of uranium and molybdenum species were considered as potential sorbents (Table 5-4). These include the free uranyl (UO_2^{2+}) as provided in the WATQ4F database which accompanies the PHREEQC program. The uranyl surface complexation constants (Dzombak and Morel, 1990) were subsequently revised based on the improved constants published by Mahoney et al. (2009). Additional adsorbing species considered are the various uranium-carbonate and -calcium complexes (including the carbonate ion) for which thermodynamic data have been developed (Table 5-4). The modified MINTEQv4.dat geochemical database is provided in Appendix G.

Table 5-3 – Supplemental Thermodynamic Data for Uranium Species in the Modified Database

Reaction	Log K	Source
$\text{Ca}^{+2} + \text{UO}_2^{+2} + 3\text{CO}_3^{-2} = \text{CaUO}_2(\text{CO}_3)_3^{-2}$	27.18	Dong and Brooks (2006)
$2\text{Ca}^{+2} + \text{UO}_2^{+2} + 3\text{CO}_3^{-2} = \text{Ca}_2\text{UO}_2(\text{CO}_3)_3$	30.70	
$\text{Mg}^{+2} + \text{UO}_2^{+2} + 3\text{CO}_3^{-2} = \text{MgUO}_2(\text{CO}_3)_3^{-2}$	25.02	Dong and Brooks (2006)

Table 5-4 – Uranium and Molybdenum Reactions Considered in Surface Complexation Mixing Model

No.	Reaction	Log K	Source
1	$\text{Hfo_sOH} + \text{UO}_2^{+2} = \text{Hfo_sOUO}_2^{+} + \text{H}^{+}$	3.735	Mahoney et al. (2009)
2	$\text{Hfo_wOH} + \text{UO}_2^{+2} = \text{Hfo_wOUO}_2^{+} + \text{H}^{+}$	2.534	
3	$\text{Hfo_wOH} + \text{UO}_2^{+2} + \text{CO}_3^{-2} = \text{Hfo_wOUO}_2\text{CO}_3^{-} + \text{H}^{+}$	9.034	
4	$\text{Hfo_wOH} + \text{UO}_2^{+2} + 2\text{CO}_3^{-2} = \text{Hfo_wOUO}_2(\text{CO}_3)_2^{-3} + \text{H}^{+}$	15.28	
5	$\text{Hfo_wOH} + \text{Ca}_2\text{UO}_2(\text{CO}_3)_3 + 2\text{H}^{+} = \text{Hfo_wOUO}_2^{+} + 3\text{HCO}_3^{-} + 2\text{Ca}^{+2}$	3.01	NRC (2006)
6	$\text{Hfo_wOH} + \text{Ca}_2\text{UO}_2(\text{CO}_3)_3 + \text{H}^{+} + \text{H}_2\text{O} = \text{Hfo_wOUO}_2\text{OH} + 3\text{HCO}_3^{-} + 2\text{Ca}^{+2}$	-4.88	
7	$\text{Hfo_sOH} + \text{Ca}_2\text{UO}_2(\text{CO}_3)_3 + 2\text{H}^{+} = \text{Hfo_sOUO}_2^{+} + 3\text{HCO}_3^{-} + 2\text{Ca}^{+2}$	6.25	
8	$\text{Hfo_sOH} + \text{Ca}_2\text{UO}_2(\text{CO}_3)_3 + \text{H}^{+} + \text{H}_2\text{O} = \text{Hfo_sOUO}_2\text{OH} + 3\text{HCO}_3^{-} + 2\text{Ca}^{+2}$	-1.65	
9	$\text{Hfo_wOH} + \text{CO}_3^{-2} + \text{H}^{+} = \text{Hfo_wOCO}_2^{-} + \text{H}_2\text{O}$	12.78	Appelo et al. (2002)
10	$\text{Hfo_wOH} + \text{CO}_3^{-2} + 2\text{H}^{+} = \text{Hfo_wOCO}_2\text{H} + \text{H}_2\text{O}$	20.37	
11	$\text{Hfo_sOH} + \text{MoO}_4^{-2} + \text{H}^{+} = \text{Hfo_sMoO}_4^{-} + \text{H}_2\text{O}$	9.50	USEPA (1998)
12	$\text{Hfo_wOH} + \text{MoO}_4^{-2} + \text{H}^{+} = \text{Hfo_wMoO}_4^{-} + \text{H}_2\text{O}$	9.50	
13	$\text{Hfo_sOH} + \text{MoO}_4^{-2} = \text{Hfo_sOHMoO}_4^{-2}$	2.40	
14	$\text{Hfo_wOH} + \text{MoO}_4^{-2} = \text{Hfo_wOHMoO}_4^{-2}$	2.40	

5.4.2 Geochemical Model Description

The SCMM combines surface complexation reactions with geochemical mixing of groundwater to calculate uranium and molybdenum partition coefficient values (K_f) using the Freundlich isotherm. The values for K_f are in turn used to calculate uranium and molybdenum retardation factor values (R_f) to define their degree of attenuation in the groundwater flow model. In the SCMM, upgradient groundwater is mixed with varying proportions of tailings-influenced groundwater (ranging from 0.10% to 98%) in the presence of ferrihydrite, clays, and other major minerals (quartz, feldspar, calcite). This approach allows for the generation of empirical adsorption isotherms to account for the large range in COC and TDS concentrations encountered upon migration and mixing of the contaminant plume with alluvial groundwater. All groundwater solution compositions and aquifer mineral component inputs to the SCMM are based on site-specific measurements conducted in 2018 (WME, 2018).

The two end-member solution compositions used in the SCMM are provided in Table 5-5. The composition of upgradient water represents average 2018 concentrations calculated from upgradient Wells DD, R, and Q (Quarters 1 through 3). The composition of the tailings-influenced water is representative of the alluvial groundwater containing the highest concentrations of uranium and molybdenum measured in the vicinity of the LTP (Well SE6) (HMC and HE, 2018). The mineralogic inputs are based on recent site-specific characterization (WME, 2018) as shown in Table 5-6. The alluvium is dominated by quartz, and therefore a particle density of 2.65 grams/cubic centimeter (g/cm^3) and a porosity of 0.30 were used to calculate a bulk density of $1.86 \text{ g}/\text{cm}^3$ (Klein and Hurlbut 1993; WME, 2018). For consistency with the groundwater flow model, an effective porosity of 0.20 was used with the calculated bulk density of $1.86 \text{ g}/\text{cm}^3$ to convert mineral concentrations from a mass basis (mg/kg) to moles/L of pore water for input to PHREEQC (Table 5-6). Mineral saturation index values were fixed at their respective average values in groundwater as previously calculated (WME, 2018).

Table 5-5 – Groundwater Compositions (mg/L) Used in the Surface Complexation Mixing Model

Constituent	Upgradient	Tailings Influenced
Alkalinity as CaCO_3	192.4	4,295
Calcium	411	33
Magnesium	77.8	66.3
Sodium	314	7,150
Potassium	5.9	8.9
Chloride	66.1	1,200
Sulfate	1704	9,980
pH (s.u.)	7.4	8.47
Dissolved Oxygen	2.4	3.2
Temperature ($^{\circ}\text{C}$)	16.2	15.5
Uranium	0.063	45
Molybdenum	0.004	71.5
Selenium	0.377	3.7

Table 5-6 Mineralogical Data and PHREEQC Input Used in the Surface Complexation Mixing Model

Constituent	Average Concentration	Model Input Concentration (moles/L)	Saturation Index (SI)
Quartz (α -SiO ₂)	69%	10	0.72
K-Feldspar (KAlSi ₃ O ₈)	7.6%	2.5	-0.10
Calcite (CaCO ₃)	8.7%	8.05	0.18
Kaolinite [Al ₂ Si ₂ O ₅ (OH) ₄]	1.7%	0.61	3.4
Ferrihydrite [Fe(OH) ₃ (am)]	0.05%	0.084	1.4
Exchange Phase (X)	4.9 cmol-/kg	0.46	NA

The properties of the adsorbing surface in the SCMM were defined to be consistent with those of ferrihydrite. The SCMM uses 0.2 moles of weak sites ("hydrous ferric oxide," analogous to ferrihydrite, or Hfo_w) and 0.005 moles of strong sites (Hfo_s) per mole of iron, and a surface area of 5.33×10^4 m²/mole iron (Dzombak and Morel, 1990). The total number of adsorption sites were allowed to vary with mixing by linking the amount of adsorbing surface to the mass of ferrihydrite, which was allowed to precipitate or dissolve as needed to maintain the ferrihydrite saturation index of +1.4 (Table 5-6). The amount of ferrihydrite was assumed to be 0.05% as iron based on selective extraction results (Table 5-2). However, because prior visual estimates of alluvial iron content (up to 3%) were higher than those detected using XRD (HMC, 2018), two additional ferrihydrite contents were evaluated by assuming that the average iron contents reported by HMC (2018) in Table 5-2 represent an amorphous iron phase consistent with ferrihydrite. The additional ferrihydrite contents included the average content for alluvial sands (0.529% or 5,290 ppm as iron) and the overall average for alluvium samples (1.0855% or 1,885 ppm as iron) reported by HMC (2018) (Table 5-2). The PHREEQC input files for uranium and molybdenum simulations in the SCMM are provided in Appendix G.

5.4.3 Geochemical Modeling Results

The SCMM which simulates the mixing of upgradient water with tailings-influenced water (ranging from 0.01 to 98%) in the presence of ferrihydrite was run using a range in ferrihydrite content, and by evaluating the effects of varying species adsorption (Table 5-4) on the calculated K_f value. Adsorption curves showing the adsorbed concentration (mg/kg) versus the equilibrium solution concentration (mg/L) were prepared and the data were also plotted as the linear form of the Freundlich isotherm (Equation 1):

$$\log x/m = 1/n \log C + \log K \quad [2]$$

The linear form of the Freundlich isotherm (Equation 2) produces a slope of $1/n$ and an intercept of $\log K$ from which the empirical partition coefficient (K_f) can be derived.

The initial model simulation considered the adsorption of uranyl (UO₂²⁺) using the default surface complexation reactions from PHREEQC (WATEQ4F database), but incorporating the revised constants from Mahoney et al. (2009) (Table 5-4). The model results (Figure 5-8) are consistent with a typical adsorption isotherm, where at a given ferrihydrite content, the maximum degree of adsorption occurs at low uranium concentrations, followed by increasingly less adsorption at higher concentrations (Langmuir, 1997). The amount of adsorbed uranium also increases with increasing iron (ferrihydrite) content for any given equilibrium solution concentration. However, the amount of uranium predicted to be adsorbed (Figure 5-8) in this simulation is orders of magnitude lower compared to the amount measured from tailings-influenced alluvium samples using selective extraction (Figure 5-3). Subsequent additional model simulations were therefore conducted

by considering additional potential adsorption reactions involving the uranium-carbonate and uranium-calcium complexes (Table 5-4).

The additional simulations which included adsorption of the uranium-carbonate species (Reactions 3 and 4, Table 5-4) produced K_f values and resulting R_f values which were too low to account for the observed plume behavior, unless the uranium-calcium and uranium-carbonate surface species were also included (Reactions 5 through 9, Table 5-4). When both uranium-carbonate and uranium-calcium complexes were considered, the extent of uranium adsorption was overpredicted for the higher average sands iron content (5,290 ppm) and the overall average iron content (10,885 ppm). Overprediction was indicated by unreasonably high calculated uranium solid phase concentrations (mg/kg), and calculated uranium equilibrium solution concentrations at the 98% tailings composition which were far below the observed concentration in tailings-impacted groundwater.

Subsequent sensitivity runs therefore focused on using the measured ferrihydrite contents from selective extractions (0.05% or 500 ppm as iron, Table 5-2), where the effects of competitive carbonate adsorption (Reactions No. 9 and 10, Table 5-4) were next evaluated. Uranium adsorption was slightly overpredicted as indicated by equilibrium concentrations which ranged from approximately 20 to 35 mg/L at the highest tailings water mixture (98% tailings-influenced water from Well SE6 which contained 45 mg/L uranium, Table 5.5). To account for the slight overprediction, the initial concentration of uranium in the tailings-influenced water was increased to 100 mg/L (Appendix G), consistent with the average value of 150 mg/L reported by USEPA (1975) for HMC tailings water (Table 5-1). Using a log PCO_2 of -1.2 within the range of values calculated for the groundwater (WME, 2018) produced modeled equilibrium uranium concentrations more consistent with observed concentrations in the tailings-impacted groundwater, the result of reaction of the historic tailings water with unimpacted alluvium. The results on Figure 5-9 show that predicted uranium adsorption was lowest when both adsorbing carbonate species (Reactions 9 and 10, Table 5-4) were included due to competitive adsorption. The highest uranium adsorption was predicted when only the CO_2H surface species was considered (Reaction 10, Table 5-4). This simulation produced a final equilibrium uranium concentration at 98% tailings-influenced water of 48.3 mg/L, which agrees well with observed concentration (45 mg/L) in the tailings-influenced alluvial water (Table 5-5).

The maximum adsorbed uranium concentration (5.26 mg/kg) is higher, but similar in magnitude to the highest value (2.24 mg/kg) from selective extraction of impacted alluvium (sample WME-16, Figure 5-3), assuming that both the exchangeable fraction and Fe/Mn oxide bound fraction represent adsorbed uranium (Section 5.2). The extent of predicted uranium adsorption is also consistent with similar studies of alluvium where uranium is likely associated with ferrihydrite under oxidizing conditions, for example: (1) up to 8 mg/kg total uranium at Rifle, CO (Johnson et al., 2018), (2) 0.12 to 2.87 mg/kg adsorbed uranium from selective ferrihydrite extraction at Naturita, CO (NRC, 2003b), (3) 0.46 to 4.4 mg/kg adsorbed uranium from bicarbonate extraction at Richland, WA (Stoliker et al., 2011).

The resulting Freundlich log K_f values for uranium in these model runs (Figure 5-10) ranged from -4.399 to -3.532, where the highest log K_f of -3.532 corresponds to the adsorption data curve for 500 ppm iron (Figure 5.9). This model considers all adsorbing species in Table 5-4 with the exception of Reaction 9 for the CO_2 -species. The log K_f of -3.532 for uranium was found to be the best predictor of uranium plume migration based on groundwater transport calibration (Section 5.6). The SCMM molybdenum adsorption isotherm (Figure 5-11) and corresponding linear Freundlich isotherm plot (Figure 5-12) were developed under the identical set of model inputs and constraints. The maximum amount of molybdenum predicted to be adsorbed (3 mg/kg, Figure 5-11) is consistent with the amount extracted from the exchangeable and iron oxide fractions (2 mg/kg) from a tailings-influenced alluvium sample adjacent to the LTP (WME, 2018).

Successful transport calibration for Mo was also achieved using the log K_f of -3.66 (Section 5.6), providing further support for the SCMM approach.

5.5 Transport Model Parameterization

Using the current calibration of the groundwater flow model, additional constituent models were developed to simulate uranium and molybdenum fate and transport at the GRP and immediate vicinity as described below.

5.5.1 Transport Model Code Selection

The groundwater transport model simulations are conducted using MT3D-USGS (Bedekar et al. 2016). MT3D-USGS was selected as the transport simulation code because it is the most recent release of the MT3D code and includes an update allowing compatibility with the handling of model dry cells in the MODFLOW-NWT Newton-Raphson formulation. Transport simulations were performed using the finite-difference approach for advection. The transport modeling includes simulation of dispersion and geochemical attenuation processes through Freundlich non-linear adsorption isotherms as described previously in Section 5. The non-linear adsorption isotherm requires that model concentration units be based on volumetric units that match the length units of the model grid, so concentrations are converted from mg/L to mg/ft³ in the model inputs for initial concentrations, recharge concentrations, and injection concentrations. Upon completion of model simulations, output concentrations are then converted back to mg/L from mg/ft³ using a Python script.

5.5.2 Transport Model Input Parameters

The solution obtained from the preliminary groundwater flow model was used to simulate transport of uranium and molybdenum at the GRP site.

In order to calibrate the transport model to observed conditions, initial concentration source zones were interpolated to the model grid using 2013 interpreted plume map contours, 2013 analytical data from well sampling, and 2014 interpreted plume map contours (HE, 2014 and HE, 2015). This was performed for both uranium and molybdenum in the alluvial aquifer, Upper Chinle aquifer, Middle Chinle aquifer, and Lower Chinle aquifer (uranium only). All shale units and the SAG were assigned concentrations equal to background. Initial uranium plume area concentrations in the alluvial aquifer were only slightly modified from their interpolated values during calibration. Initial condition molybdenum concentrations were not adjusted from their initial interpolated values.

To initialize the transport model, values of 0.02 mg/L and 0.003 mg/L were assigned for uranium and molybdenum, respectively, in areas unimpacted by the GRP Site. This includes portions of the model including the SAG aquifer (Layer 10), all Chinle Shale representations, and alluvial areas that are unaffected by the GRP Site. Re-injection concentrations associated with GRP site remedial activities were set equal to 0.01 mg/L for uranium and 0.003 mg/L for molybdenum.

Freundlich sorption parameters developed from the geochemical modeling were directly applied for transport modeling for both uranium and molybdenum. The only adjustment from geochemical model output was to convert units to those consistent with MT3D-USGS requirements, which lead to the retardation factor versus concentration relationships provided in Figures 5-13 and 5-14 (presented here in mg/L rather than mg/ft³).

Other transport parameterization included values for bulk density and porosity. The velocity of the constituents of interest in groundwater are directly related to the effective porosity of the porous medium. A single effective porosity of 0.20 was assigned to the Alluvial aquifer. All other effective porosity values assigned to bedrock units are equal to their respective specific yield values. The bulk density used in the transport model is 2.12 grams/cubic centimeter (g/cm³), calculated from an effective porosity value of 0.20 and a particle density of 2.65 g/cm³ because the alluvium is dominated by quartz (Klein and Hurlbut, 1993; WME, 2018).

Dispersivity quantifies the degree to which mechanical dispersion of constituent occurs in advection of groundwater. Dispersivity values were assigned to the current model construct from a previous model developed by Hydro-Engineering for the GRP site (HMC, 2012). Sensitivity to dispersivity was evaluated during early model calibration and results showed that the model is generally insensitive to dispersivity. As such, lower dispersivity values of 20 feet, 0.1 feet, and 0.1 feet (longitudinal, traverse horizontal, transverse vertical) were retained in this model. The use of the finite difference solution for transport simulations can introduce a degree of artificial numerical dispersion, spreading constituents along groundwater flow paths at a rate similar to that expected to occur due to mechanical dispersion. A widely accepted and broadly used approach to minimizing numerical dispersion is to employ model grid spacing that has a dimensionless Peclet number (grid cell spacing divided by dispersivity) under 4 (Voss, 1984). For the refined portion of the model grid the Peclet number is 3.125 (62.5 feet divided by 20 feet).

5.6 Transport Model Results

Transport model calibration results for uranium and molybdenum were evaluated based upon visual comparison of simulated contours and well chemographs to observed data. Results for uranium transport, followed by molybdenum, are described below. Transport calibration target locations for both uranium and molybdenum are provided in Figures 5-15 through 5-19.

5.6.1 Uranium Transport Calibration Results

Simulated uranium concentrations by the transport model generally reflect both observed plume footprints and plume concentration changes through time as compared to uranium concentration contours and well chemographs derived from analytical data.

Figures 5-20 through 5-27 provide comparisons of observed versus simulated uranium contours for the different aquifer units in years 2015 and 2017. For year 2015, the transport model simulates uranium contours greater than 0.1 mg/L extending westward from the GRP that are consistent with observed values (Figure 5-20). Simulated uranium contours within the LTP and STP footprint and southeast of the STP are also reflective of contours derived from analytical data and included in annual reporting (HE, 2016). On the east side of the bedrock high, the transport model simulates the plume extending south and southwestward through a narrow zone of alluvium saturation, but simulated concentrations of uranium are slightly lower than observed values (Figure 5-20). The model simulates a lobe of elevated uranium concentrations northwest of the LTP, which is a result of deriving the initial condition from analytical data that captures naturally occurring elevated uranium concentrations in the area of the DD and DD2 wells (HMC, 2018c).

Simulated 2015 uranium contours for the Upper Chinle (Figure 5-21), Middle Chinle (Figure 5-22), and Lower Chinle (Figure 5-23) aquifers are consistent with observed contours included in GRP annual reports (HE, 2016).

In year 2017, transport model results approximate uranium concentrations for locations extending west from the LTP, within the general footprints of the LTP and STP, and southeast of the STP (Figure 5-24). In areas adjacent to the bedrock high, the model simulates reduction of uranium concentration that occurs more quickly than has been recently observed. Figure 5-25 provides Upper Chinle aquifer simulated uranium contours for 2017 that are consistent with those derived based on analytical data. Figure 5-26 shows that the model replicates Middle Chinle concentrations consistent with data collected from areas west of the LTP and south of the NRC License boundary. Approximately 0.5 mi northwest of the LTP, the model continues to simulate an area of slightly elevated uranium concentrations that, while present in 2015, is no longer observed in 2017 (Figure 5-26). For the Lower Chinle aquifer, the model simulates uranium concentrations that are generally consistent with analytical data values for this hydrostratigraphic unit (Figure 5-27).

Figures 5-28 through 5-35 provide select timeseries chemographs for well target locations, which are shown on the previous uranium concentration contour maps (chemographs for all target locations are provided in

Appendix C and all transport target data is provided as a table in Appendix D). For alluvial well 0881-AI located in plume area west of the LTP, the model simulates concentrations and trends consistent with analytical data collected from this well (Figure 5-28). At wells M9-AI and D1-AI, transport results do not replicate the variability in observed data but the model captures the gradual decreasing trend in uranium in these areas of the GRP (Figures 5-29 and 5-30). As noted previously, targets within the southern offsite plume (0497-AI and 0864-AI) slightly underestimate observed uranium values but simulated results capture the trend in concentrations over the 5-year simulation period (Figure 5-31 and 5-32).

Select chemographs for target locations in the Upper, Middle, and Lower Chinle aquifers are provided in Figures 5-33 through 5-35, respectively. In the Upper Chinle aquifer, the transport model simulates both uranium concentrations and trends that are consistent with observed data (Figure 5-33). At target location CW44-MC in the Middle Chinle aquifer, the model only slightly overestimates concentrations relative to well analytical data and the simulation captures the gradual decreasing trend in uranium with time (Figure 5-34). In the Lower Chinle aquifer, the model simulates a slight decreasing trend in concentrations at Well CW29-LC, which is consistent with analytical data from this location (Figure 5-35).

All concentrations simulated for the SAG aquifer are equal to model initialization values for the entire simulation period.

Overall, the preliminary transport model simulates distribution and changes in uranium concentrations at the GRP for all four aquifer units (alluvium, Upper Chinle, Middle Chinle, and Lower Chinle) that are consistent with observed conditions.

5.6.2 Molybdenum Transport Calibration Results

Simulated molybdenum transport results are generally reflective of both observed plume footprints and plume concentration changes through time as illustrated by molybdenum concentration contours and well chemographs derived from analytical data and included in GRP annual reporting.

Figures 5-36 and 5-37 provide comparisons of observed versus simulated molybdenum contours for the alluvial and Upper Chinle aquifer in year 2015 whereas Figure 5-33 provides simulated contours for the Middle Chinle aquifer). All other aquifer units are unaffected by molybdenum concentrations that exceed GRP cleanup standards. For year 2015, the transport model simulates molybdenum concentrations of greater than 0.1 mg/L extending slightly westward from the GRP, which is consistent with observed values (Figure 5-36). Simulated alluvium molybdenum contours within the LTP and STP footprint and southeast of the STP are also reflective of contours derived from analytical data that were previously included in annual reporting (HE 2016). Simulated 2015 molybdenum contours for the Upper Chinle (Figure 5-37) are also consistent with observed contours developed for GRP annual reports (HE 2016). Figure 5-38 provides simulated molybdenum contours for the Middle Chinle where model derived concentrations are consistent with analytical data collected from GRP observation wells (see below for Middle Chinle chemographs).

In year 2017, transport model results approximate observed alluvium aquifer molybdenum contours for locations extending west from the LTP, within the general footprints of the LTP and STP, and southeast of the STP (Figure 5-39). Similarly, the transport model generates concentrations resulting in Upper Chinle aquifer molybdenum contours that are consistent with observed data (Figure 5-40). In the Middle Chinle aquifer, simulated 2017 concentrations west of the LTP are similar to those calculated by the model in 2015 (Figure 5-41).

Figures 5-42 through 5-49 provide select timeseries chemographs for well target locations, which are shown on the previous the molybdenum concentration contour maps (chemographs for all target locations are provided in Appendix C and molybdenum target data as Appendix E). For alluvial aquifer wells M9-AI and D1-AI, the model underestimates molybdenum concentrations but simulates a decreasing trend consistent with analytical data collected from these wells. For S4-AI (west of the LTP) the model only slightly overestimates observed concentrations and simulates a gradual decline in concentrations that is similar to the analytical

data timeseries. At C8-AI (northwest edge of the small tailings pile [STP]), simulated results capture concentrations and trends that are consistent with analytical data at this location within the Alluvial aquifer. At wells CE6-UC and CE15-UC, which are both screened in the Upper Chinle aquifer, simulated molybdenum concentrations through time are consistent with observed data. For the Middle Chinle aquifer well CW56-MC, the model simulates concentrations consistent with observed data in early time but the model maintains higher concentrations through 2017 while analytical data show a decreasing trend. At well CW62-MC, also a Middle Chinle well, the model simulates concentrations that are consistent with analytical data although the decline in observed concentrations is slightly more rapid than simulated by the model.

All molybdenum concentrations simulated for the Lower Chinle and SAG aquifers are equal to background values for the entire simulation period.

Overall, the preliminary transport model simulates distribution and changes in molybdenum concentrations at the GRP for all three aquifer units (alluvium, Upper Chinle, and Middle Chinle) that are consistent with observed conditions.

Section 6: Sensitivity Analysis

Additional simulations were performed to assess potential changes in calibration metrics for both groundwater flow model inputs and transport model inputs. Each type of parameter value was adjusted globally rather than by individual hydrostratigraphic unit or parameter zone.

6.1 Groundwater Flow Model Sensitivity

Hydraulic conductivity value sensitivity analyses were performed by executing six groundwater flow model simulations in which the calibrated model values were increased and decreased by 5%, 10%, and 15%. While the magnitudes for these changes may be relatively small for individual hydrostratigraphic units, the impacts of these changes are significant when applied globally across the entire model domain. Table 6-1 presents a summary of groundwater flow model bulk calibration statistics for the six hydraulic conductivity sensitivity simulations versus the calibrated model. The calibration residual mean decreases with decreasing hydraulic conductivity values and increases with increasing hydraulic conductivity values as would be expected. (Residual values are calculated as observed water level minus simulated water level such that negative residuals represent higher simulated water levels.) The calibrated model has the lowest sum of square residuals and RMSE, indicating that the calibrated model provides the best overall fit to the observed groundwater heads. This result indicates that the overall hydraulic conductivity values are reasonable; however, additional adjustments to hydraulic conductivity values for individual hydrostratigraphic units or spatial zones within hydrostratigraphic units may lead to improved model calibration.

Table 6-1 – Hydraulic Conductivity Sensitivity Bulk Simulated Groundwater Elevation Calibration Statistics

Statistic	Decrease 15%	Decrease 10%	Decrease 5%	Calibrated Model	Increase 5%	Increase 10%	Increase 15%
Residual Mean (feet)	-3.79	-2.67	-1.47	-0.47	0.46	1.33	2.12
Absolute Residual Mean (feet)	10.33	9.68	9.12	8.76	8.53	8.39	8.28
Sum of Square Residuals (feet ²)	86,261	80,993	77,457	76,140	76,342	77,846	80,536
Root Mean Squared RMS Error (feet)	13.75	13.33	13.03	12.92	12.94	13.07	13.29
Minimum Residual (feet)	-43.33	-43.49	-43.58	-43.67	-43.73	-43.77	-43.80
Maximum Residual (feet)	54.68	57.09	59.41	61.54	63.63	65.83	69.10
Number of Observations	456	456	456	456	456	456	456

Table 6-1 – Hydraulic Conductivity Sensitivity Bulk Simulated Groundwater Elevation Calibration Statistics

Statistic	Decrease 15%	Decrease 10%	Decrease 5%	Calibrated Model	Increase 5%	Increase 10%	Increase 15%
Range in Observations (feet)	207.62	207.62	207.62	207.62	207.62	207.62	207.62
Scaled RMS error (%)	6.62	6.42	6.28	6.22	6.23	6.29	6.40
Scaled Absolute Mean (%)	4.98	4.66	4.39	4.22	4.11	4.04	3.99
Scaled Residual Standard Deviation (%)	6.37	6.29	6.24	6.23	6.23	6.26	6.32

Storage parameter value sensitivity analyses were performed by executing six groundwater flow model simulations in which the calibrated model input values were increased and decreased by 5%, 10%, and 15%. These changes were applied to both specific yield and specific storage throughout the model domain. Again, although the magnitudes for these storage parameter changes may be relatively small for individual hydrostratigraphic units, the impacts of these changes are significant when applied globally across the entire model domain. Table 6-2 presents a summary of groundwater flow model bulk calibration statistics for the six storage parameter sensitivity simulations versus the calibrated model. The calibration residual mean increases with decreasing storage values, indicating that lower storage parameters lead to simulation of overall lower groundwater levels. The lower storage parameters result in simulations with very slightly lower sum of square residuals and RMSE statistics. These improvements in statistics from global storage changes are negligible, and adjustments to storage parameter values for individual hydrostratigraphic units or spatial zones within hydrostratigraphic units may provide a better approach to improvements in model calibration.

Table 6-2 – Storage Parameter Sensitivity Bulk Simulated Groundwater Elevation Calibration Statistics

Statistic	Decrease 15%	Decrease 10%	Decrease 5%	Calibrated Model	Increase 5%	Increase 10%	Increase 15%
Residual Mean (feet)	-0.34	-0.39	-0.43	-0.47	-0.51	-0.54	-0.57
Absolute Residual Mean (feet)	8.74	8.74	8.75	8.76	8.77	8.77	8.78
Sum of Square Residuals (feet ²)	75,903	75,977	76,057	76,140	76,231	76,322	76,414
Root Mean Squared RMS Error (feet)	12.90	12.91	12.91	12.92	12.93	12.94	12.95
Minimum Residual (feet)	-43.67	-43.67	-43.67	-43.67	-43.67	-43.67	-43.67
Maximum Residual (feet)	61.54	61.54	61.54	61.54	61.54	61.54	61.54
Number of Observations	456	456	456	456	456	456	456
Range in Observations (feet)	207.62	207.62	207.62	207.62	207.62	207.62	207.62
Scaled RMS error (%)	0.06	0.06	0.06	6.22	0.06	0.06	0.06
Scaled Absolute Mean (%)	0.04	0.04	0.04	4.22	0.04	0.04	0.04
Scaled Residual Standard Deviation (%)	0.06	0.06	0.06	6.23	0.06	0.06	0.06

6.2 Transport Model Sensitivity

Effective porosity value sensitivity analyses were performed by executing six uranium transport model simulations in which the calibrated model input values were increased and decreased by 5%, 10%, and 15%. These changes were applied to effective porosity throughout the model domain. Figure 6-1 presents a map of simulated uranium concentration contours in the alluvium at the site-specific standard of 0.16 mg/L at the end of 2017 showing the results of the changes to effective porosity. These adjustments had very little effect on overall simulated transport in the alluvium as evidenced by the 0.16 mg/L uranium concentration

contours nearly overlying each other. This result indicates that the transport model is generally not sensitive to input values of effective porosity over the range of values tested.

Transport model sensitivity to Freundlich sorption parameters was assessed by performing two uranium transport model simulations with Freundlich sorption parameters obtained from geochemical model sensitivity simulations. This approach was undertaken to provide a conceptual geochemical basis for the sensitivity of these parameters rather than adjusting these parameters by predetermined percentages. The first set of Freundlich sorption sensitivity parameters were derived from a geochemical model that considers adsorption of the uranyl ion (UO_2^{2+}) only ($\log K_f = -7.13$, $1/n = 0.936$). The second set of input Freundlich sorption sensitivity parameters were derived from the geochemical model used for the calibrated transport model except additionally includes CO_3^{2-} as a competing carbonate surface species with all other processes and input parameters the same ($\log K_f = -4.40$, $1/n = 0.917$). Figure 6-2 presents a comparison of retardation factors (dimensionless) for the calibrated model Freundlich parameters and the sensitivity Freundlich parameters calculated over the general range of observed aqueous uranium concentrations at the GRP site (Sharma and Reddy 2004). The retardation factor for the calibrated transport model is approximately 5.3 at low aqueous uranium concentrations and decreases to approximately 2.3 at higher aqueous uranium concentrations. The retardation factor for the first Freundlich parameter sensitivity model is approximately 1.0 (i.e., no retardation) throughout the range of aqueous uranium concentrations. The retardation factor for the calibrated transport model is approximately 1.5 at low aqueous uranium concentrations and decreases to approximately 1.3 at higher aqueous uranium concentrations.

Figure 6-3 presents a map of simulated uranium concentration contours in the alluvium at the site-specific standard of 0.16 mg/L at the end of 2017 showing the results of the changes to Freundlich sorption parameters. The first Freundlich sensitivity parameter set (virtually no retardation) was simulated to have a lesser extent of uranium above 0.16 mg/L in the North Offsite and South Offsite areas because the remedial system collection and injection is more effective in extracting and diluting uranium mass when uranium is simulated to be less retarded. The second Freundlich sensitivity parameter set (retardation factors ranging from approximately 1.3 to 1.5) was simulated to transport uranium further downgradient in the North Offsite area. This occurs because the lower retardation factor provides greater mobility of uranium that results in transport further downgradient in the North Offsite area than the calibrated model, which is not extracted and diluted as effectively as in the first Freundlich parameter sensitivity simulation. The second Freundlich sensitivity parameter set allowed greater efficacy of the South Offsite remedial system to reduce concentrations than the calibrated model but less than the first Freundlich sorption sensitivity parameters. These results indicate that the transport model results are sensitive to the Freundlich sorption parameter values.

Section 7: Summary & Future Work

HMC has developed a preliminary transient groundwater flow and transport model that is anticipated to be further refined and used to evaluate the effectiveness of ongoing and future GRP remediation efforts including fate and transport of site CoCs. In addition to the GRP Site, the model domain currently encompasses the entire SMC Basin and future work is also expected to focus on regional scale calibration, which would allow additional evaluation of basin-wide remediation efforts.

The groundwater flow model is currently calibrated to available and observed GRP groundwater conditions between years 2013 and 2017. Geochemical modeling was performed using site-specific data to develop transport parameters describing uranium and molybdenum attenuation for simulation of CoC transport across multiple aquifer units beneath the GRP Site. Transport model calibration was then achieved for the same period as the groundwater flow model. Calibration of the flow and transport model is within generally accepted criteria and the model is therefore considered a viable tool to assess future remediation efforts at the GRP Site.

Future improvements to the model may include, but may not be limited to:

- Subdivision of bedrock units above the Chinle Group into representative hydrogeologic units.
- Movement of the model representation of the San Mateo Fault north of the GRP to the east as depicted in Weston (2017).
- Increase in the overall calibration period to include previous years if pumping and injection can be reliably estimated.
- Improvement of the groundwater flow calibration in the Alluvial aquifer north of the LTP and in the South Offsite Area.
- Advancing our understanding of potential attenuation mechanisms for the underlying Chinle Formation through supplemental geochemical characterization.
- Improvement of the groundwater flow calibration east of the LTP footprint in the Upper Chinle aquifer
- Inclusion of the historical pumping records for the SAG Aquifer if they are obtainable from the New Mexico State Engineer's Office or other data sources.
- Incorporation of any revisions associated with seepage or mass loading from the Reformulated Mixing Model for the LTP.
- Recalibration of the transport model if appropriate if updates to the flow model are achieved.

Future groundwater modeling efforts will include the following tasks:

- Predictive flow and transport simulations to evaluate GRP remedial timeframes for both the existing collection/injection system and alternatives associated with the 2019 Corrective Action Plan (CAP).
- Regional flow and transport calibration including simulation of southward plume migration from the Upper SMC Basin to the Lower SMC Basin for the current model calibration period (i.e., 2013 – 2017).

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Rawling, G.C., 2013, Geologic map of the Goat Mountain 7.5-minute quadrangle, McKinley County, New Mexico: New Mexico Bureau of Geology & Mineral Resources Open-file Geologic Map 240, scale 1:24,000.

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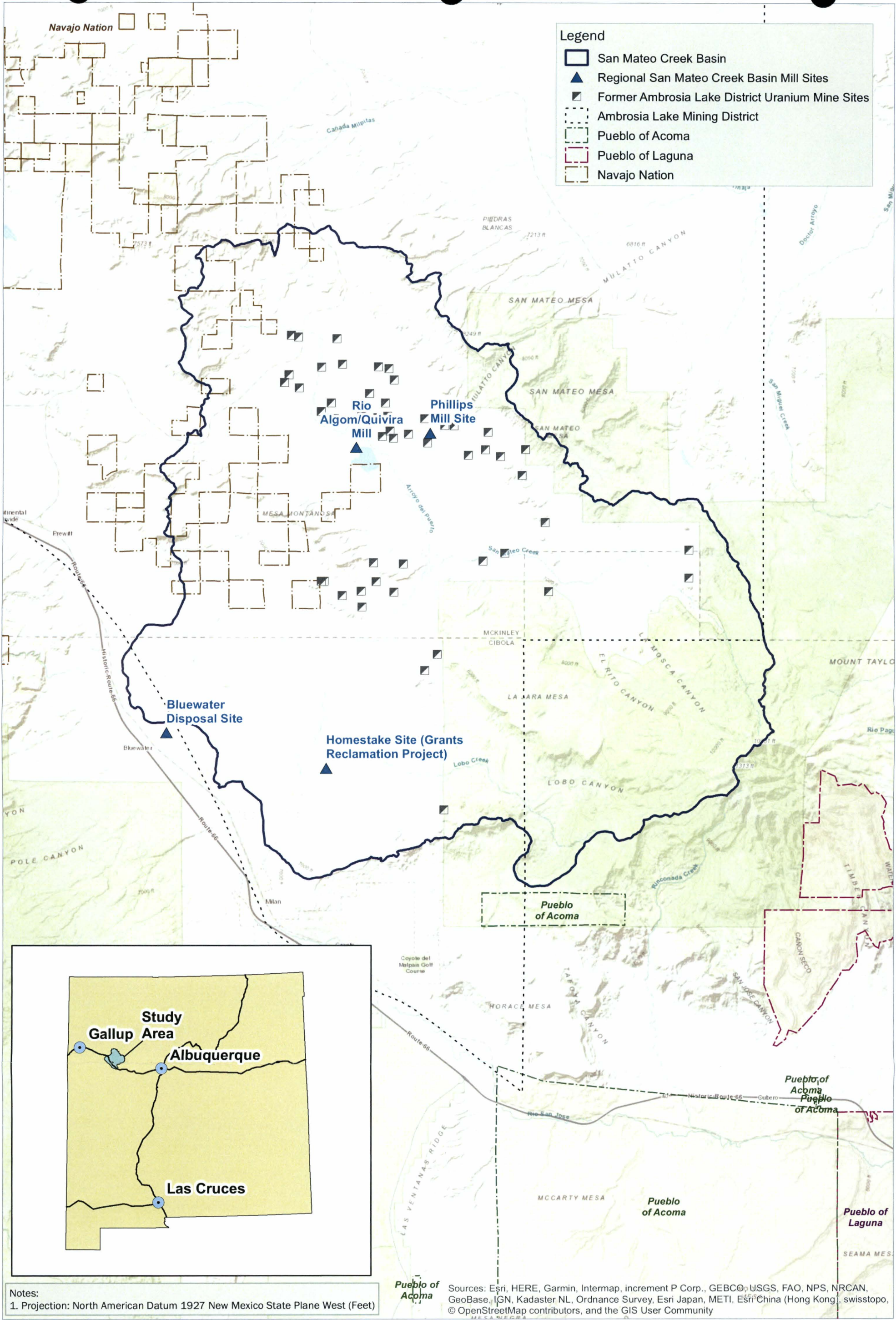
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Zeigler, K.E., Cikoski, C.T., Drakos, P.G., and Riesterer, J., 2012, Geologic map of the Grants 7.5-minute quadrangle, Cibola County, New Mexico: New Mexico Bureau of Geology & Mineral Resources Open-file Geologic Map 224, scale 1:24,000.

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Figures

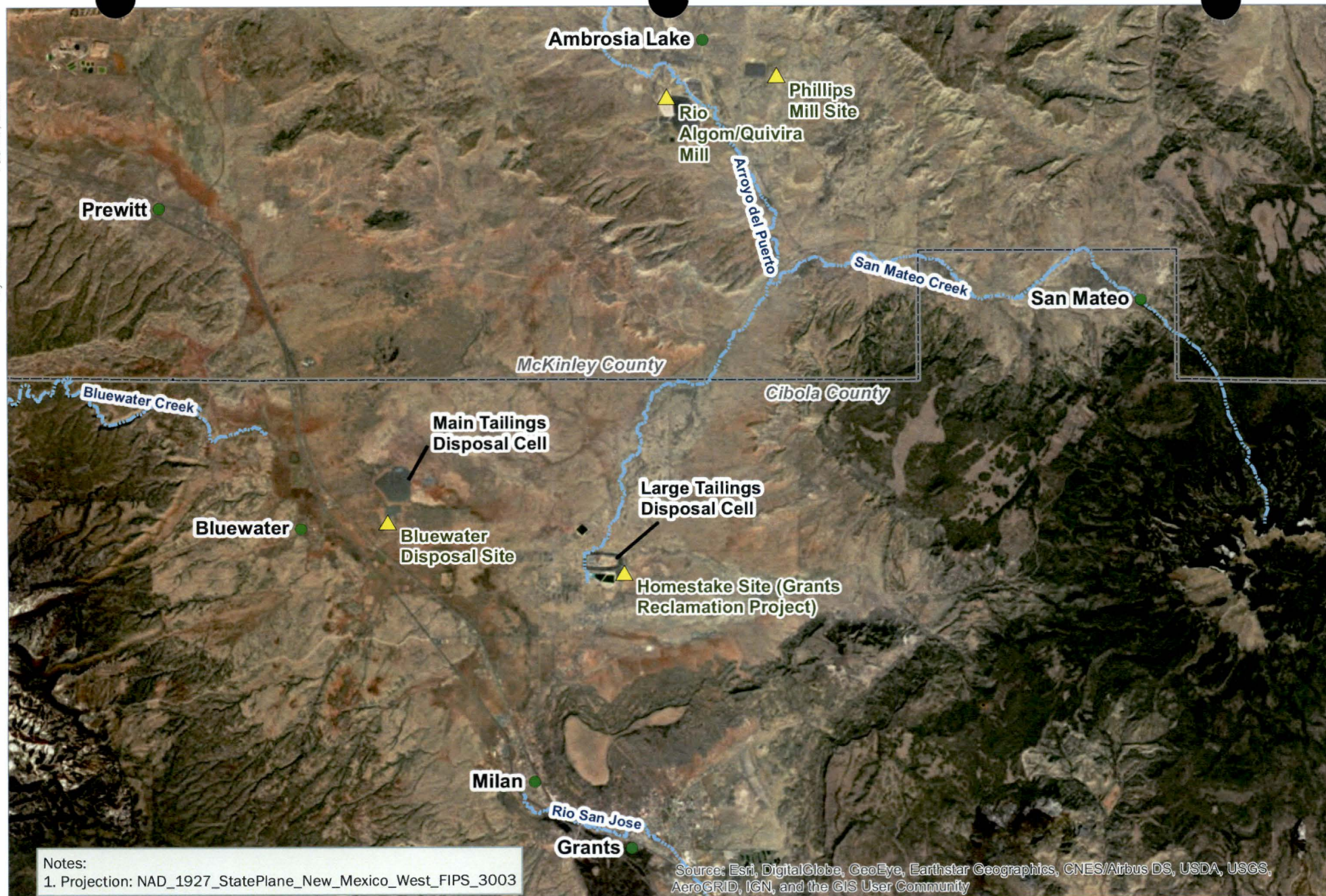
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Figure 1-1
Site Location Map



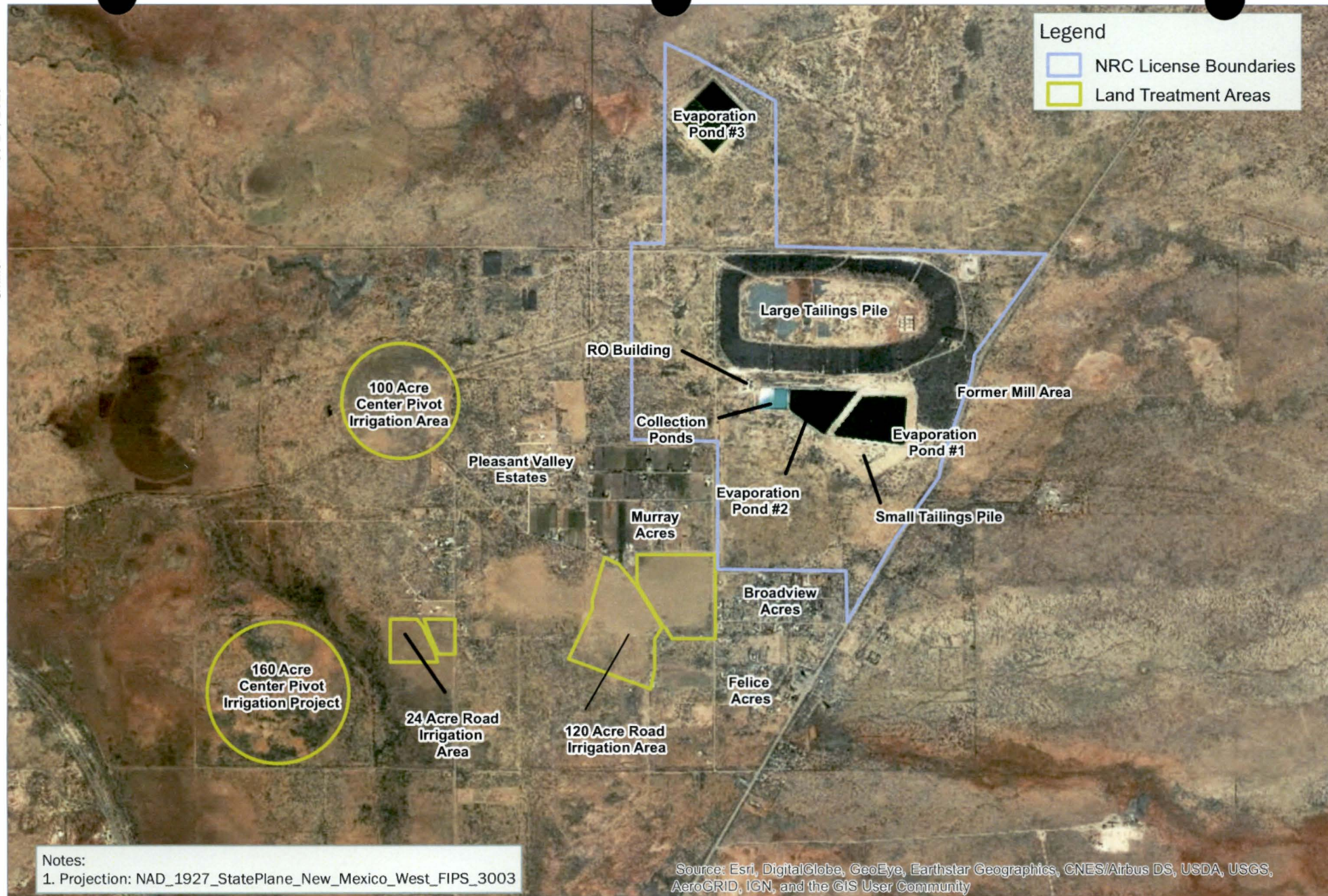
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0 1.25 2.5
Miles



Figure 1-2

Location of Historical Uranium Mill
Site Operations

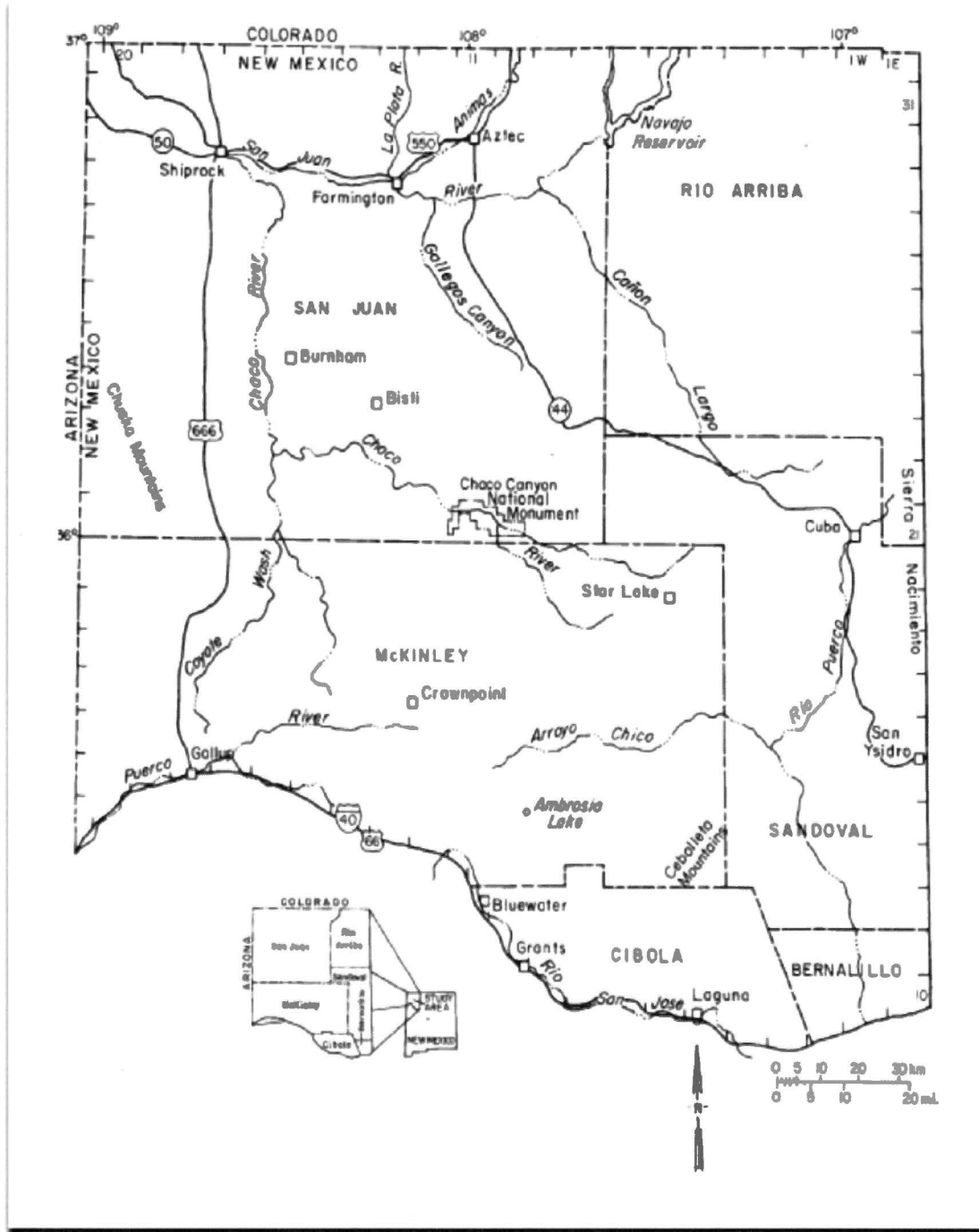


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0 0.25 0.5
 Miles



Figure 1-3
HMC Mill Site Features



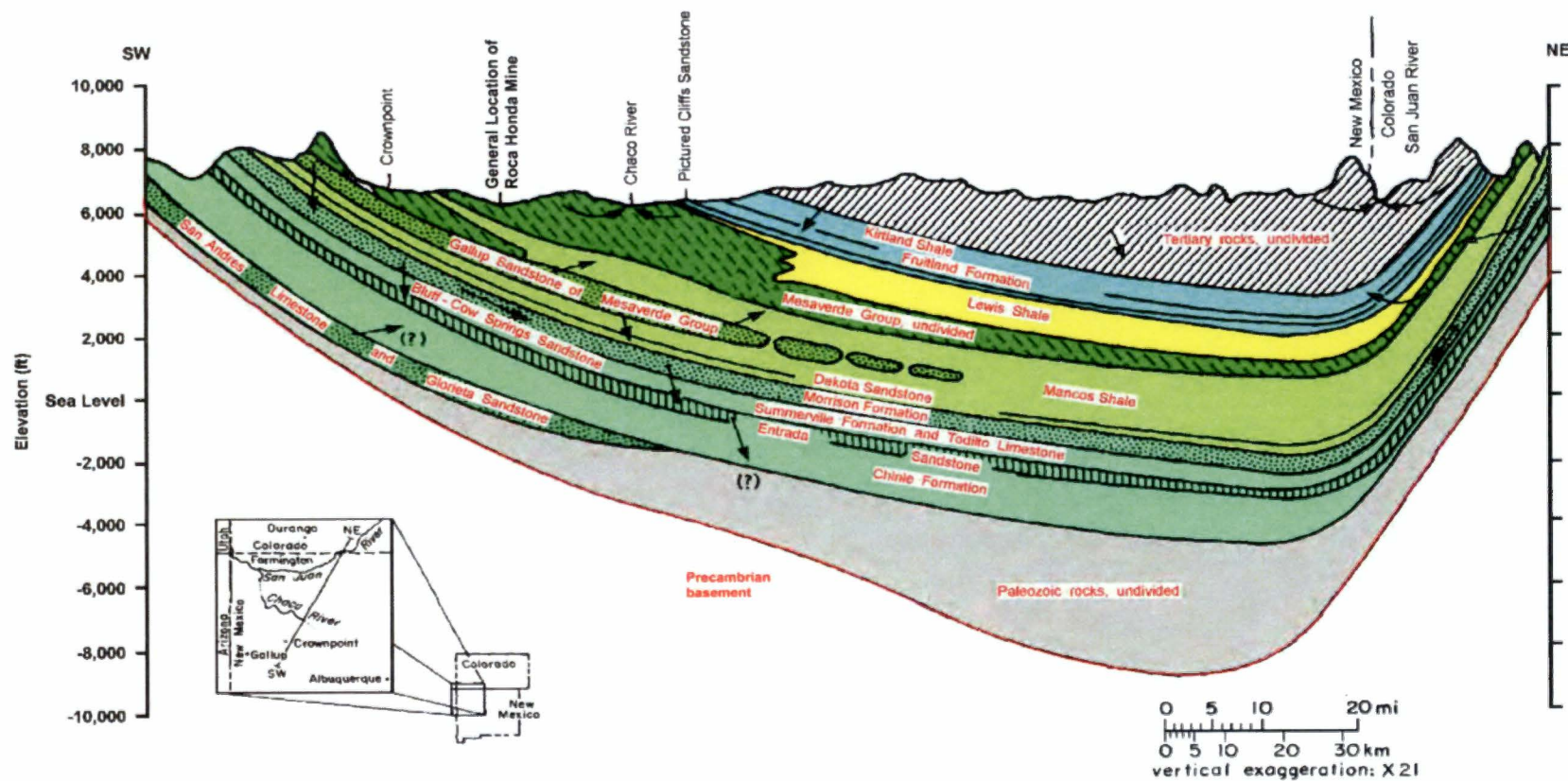
Source: Stone et al., 1983



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Figure 2-1

**Geography of Northwest New Mexico
 Including the San Juan Basin**

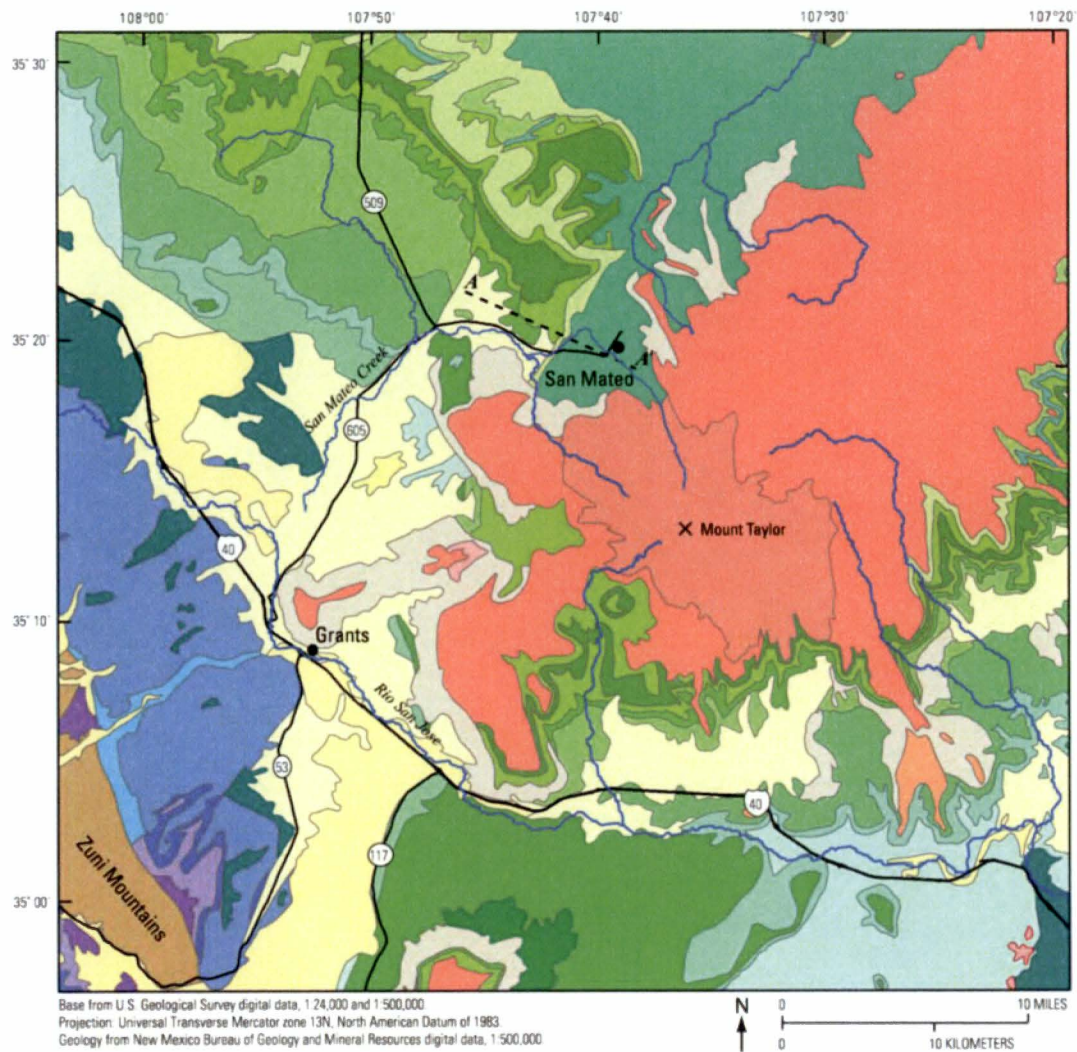


Source: INTERA, 2012



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Figure 2-2
Regional Geologic Cross Section Through the San Juan Basin



EXPLANATION

Quaternary Alluvium Landslide deposit Eolian deposit Basaltic to andesitic lava flows	Cretaceous Menefee Point Lookout Satan Tongue, Mancos Hasta Tongue, Point Lookout Mulletto Tongue, Mancos Crevasse Canyon Gallup Rio Salado Tongue, Mancos Mancos Mancos, lower Mancos and Dakota Dakota	Jurassic Upper Jurassic, undivided Morrison Lower Jurassic, undivided, may contain Entrada, Todilto, Summerville, and (or) Bluff	Permian Permian, undivided San Andres Glorieta Yeso Abo
Neogene Basaltic to andesitic lava flows (Pliocene) Basaltic to andesitic lava flows (Miocene) Silicic to intermediate volcanic rocks Intermediate to silicic volcanic rocks Intrusive rocks of intermediate to silicic composition		Triassic Chinle (Group)	Precambrian Precambrian, undivided

A--A' is a trace for a geologic cross section shown in figure 6.

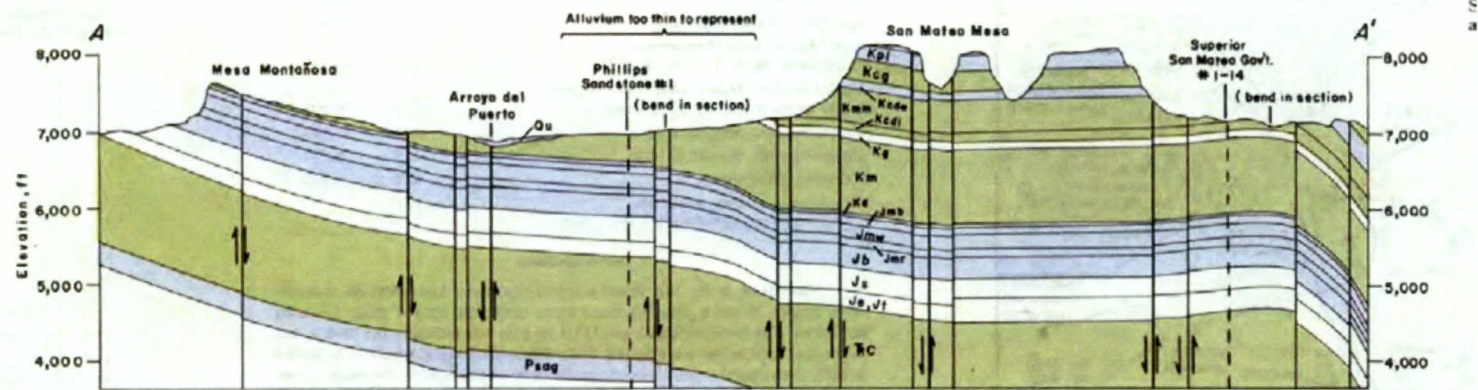
Source: Langman et al., 2012



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Figure 2-3

Surface Geology of the San Mateo
Creek Basin



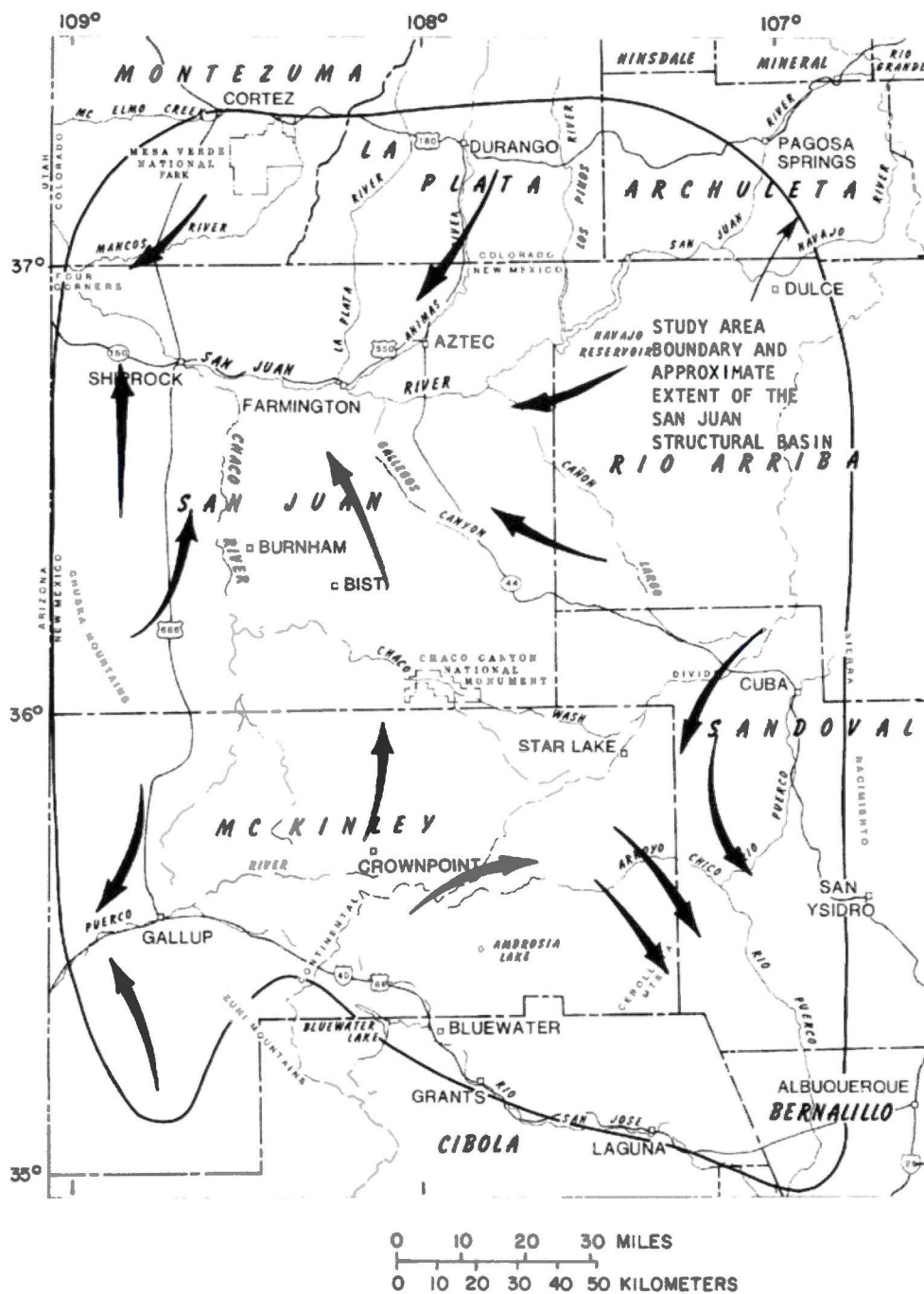
CROSS SECTION—Unit thicknesses from measured section by Brod (1979, Appendix C, section 1) and logs from wells shown.

Source: Brod and Stone, 1981



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Figure 2-4
Hydrogeologic Cross Section Through the San
Mateo Basin



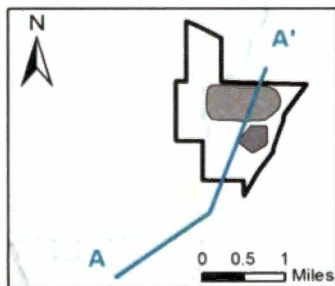
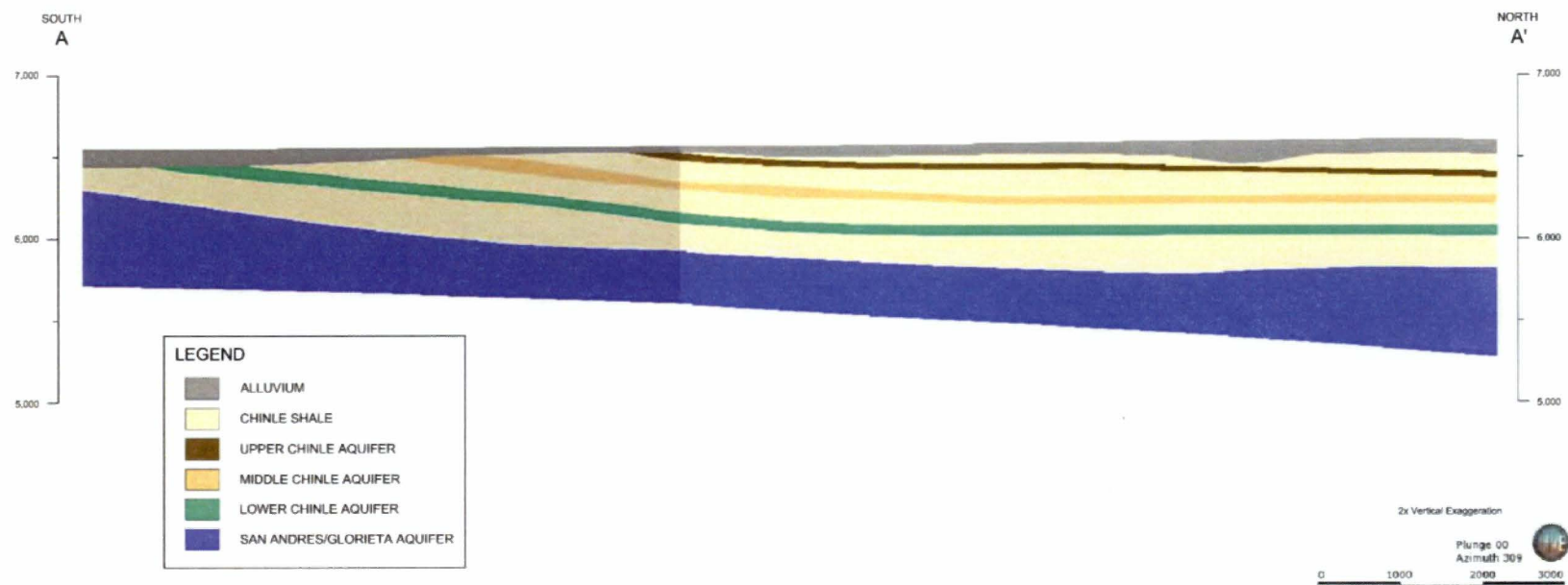
Source: Frenzel and Lyford, 1982



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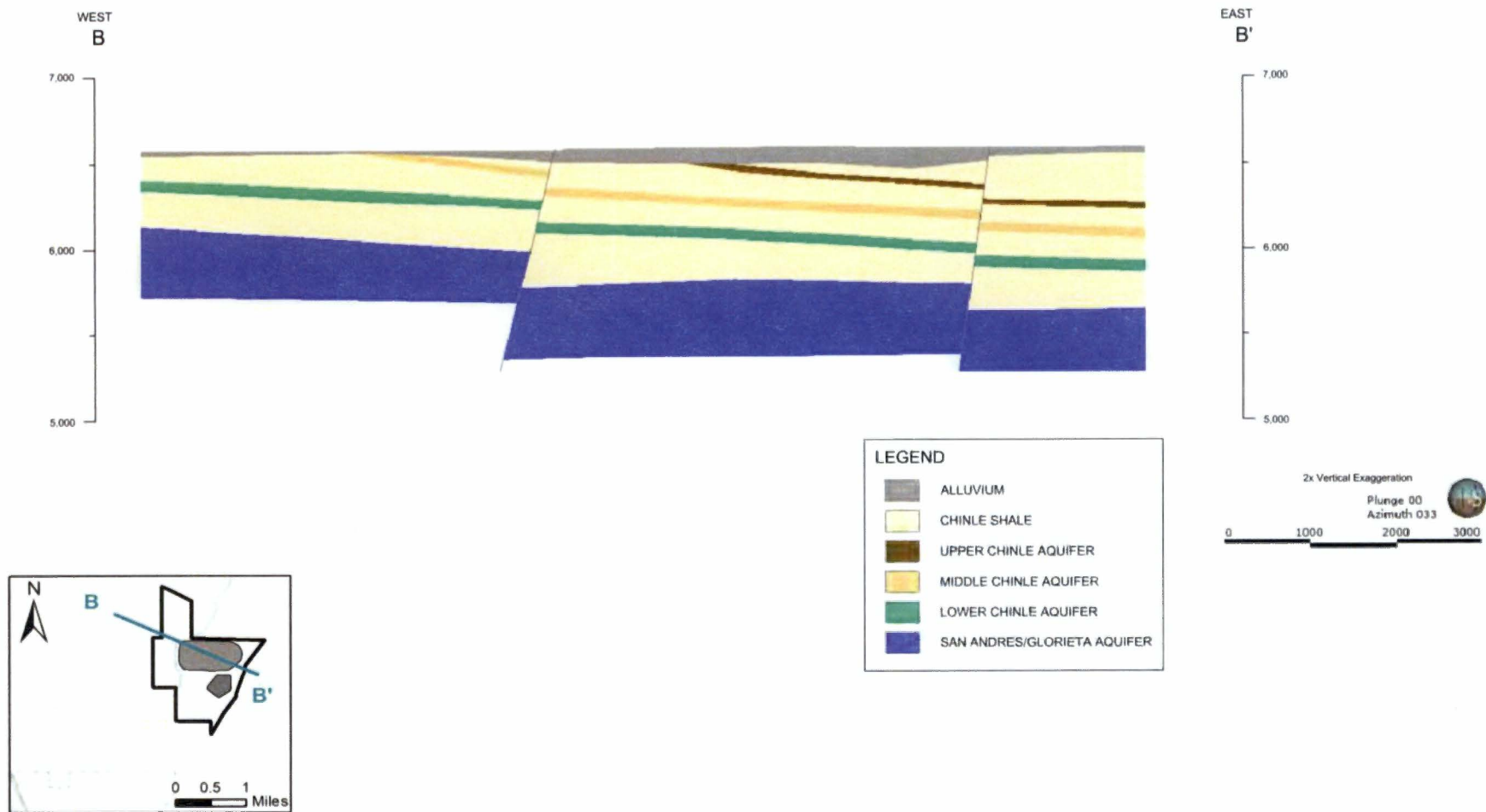
Figure 2-5

**Conceptual Groundwater Flow
Directions in Cretaceous and
Jurassic Aquifers**



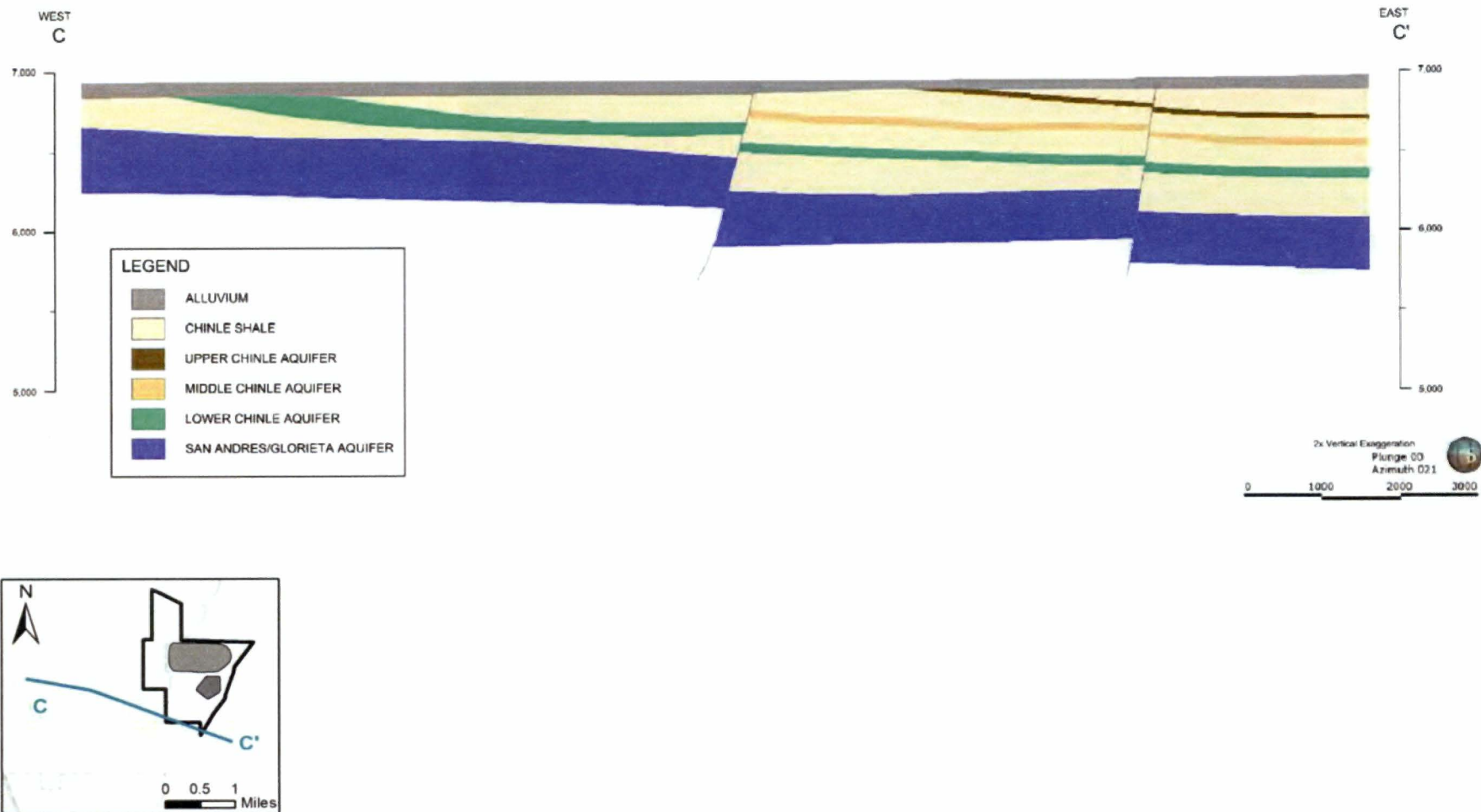
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Figure 2-6
Hydrogeologic Cross Section A-A' Through the GRP Site



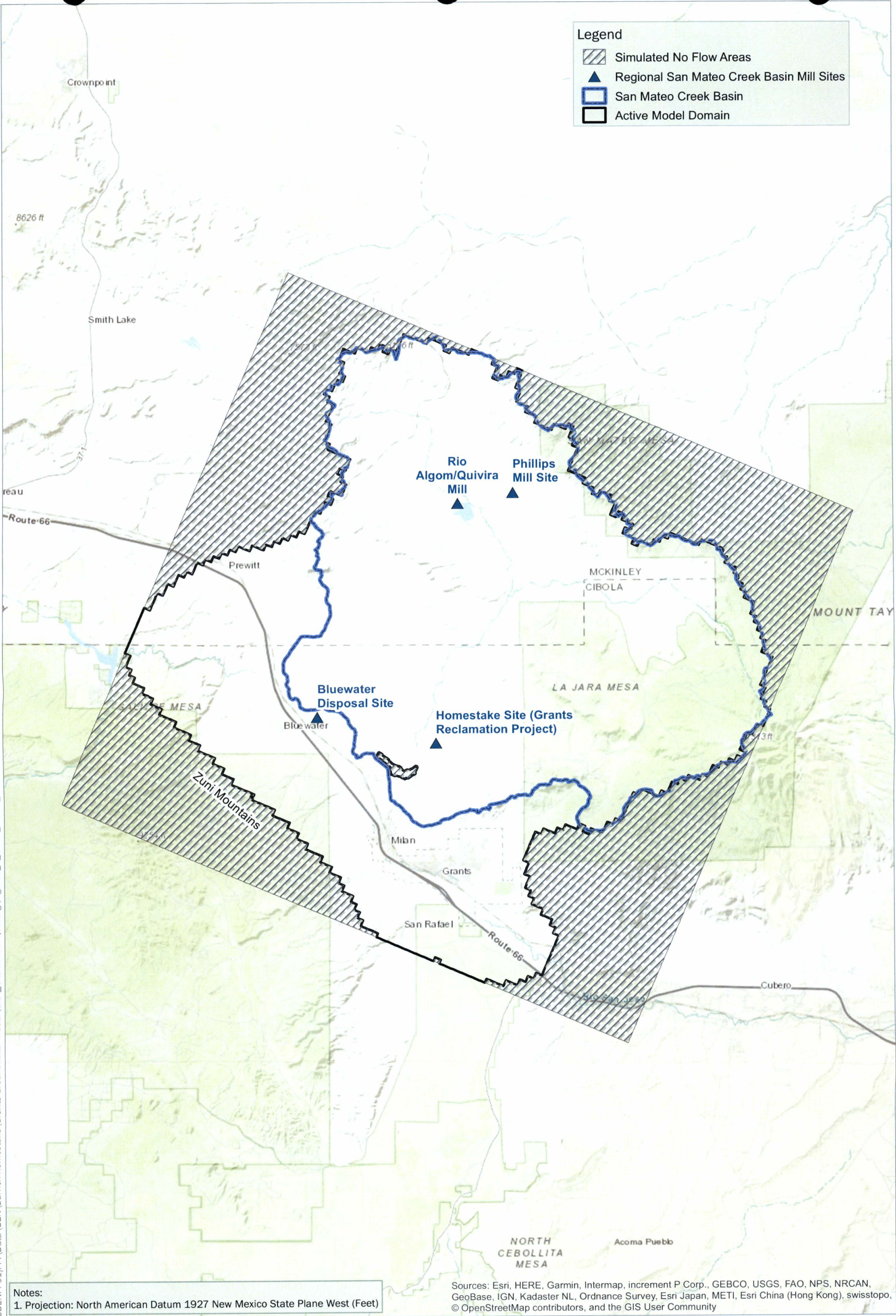
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Figure 2-7
Hydrogeologic Cross Section B-B' Through the GRP Site



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Figure 2-8
Hydrogeologic Cross Section C-C' Through the GRP Site



Notes:
1. Projection: North American Datum 1927 New Mexico State Plane West (Feet)

Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, © OpenStreetMap contributors, and the GIS User Community



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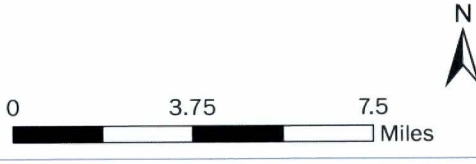
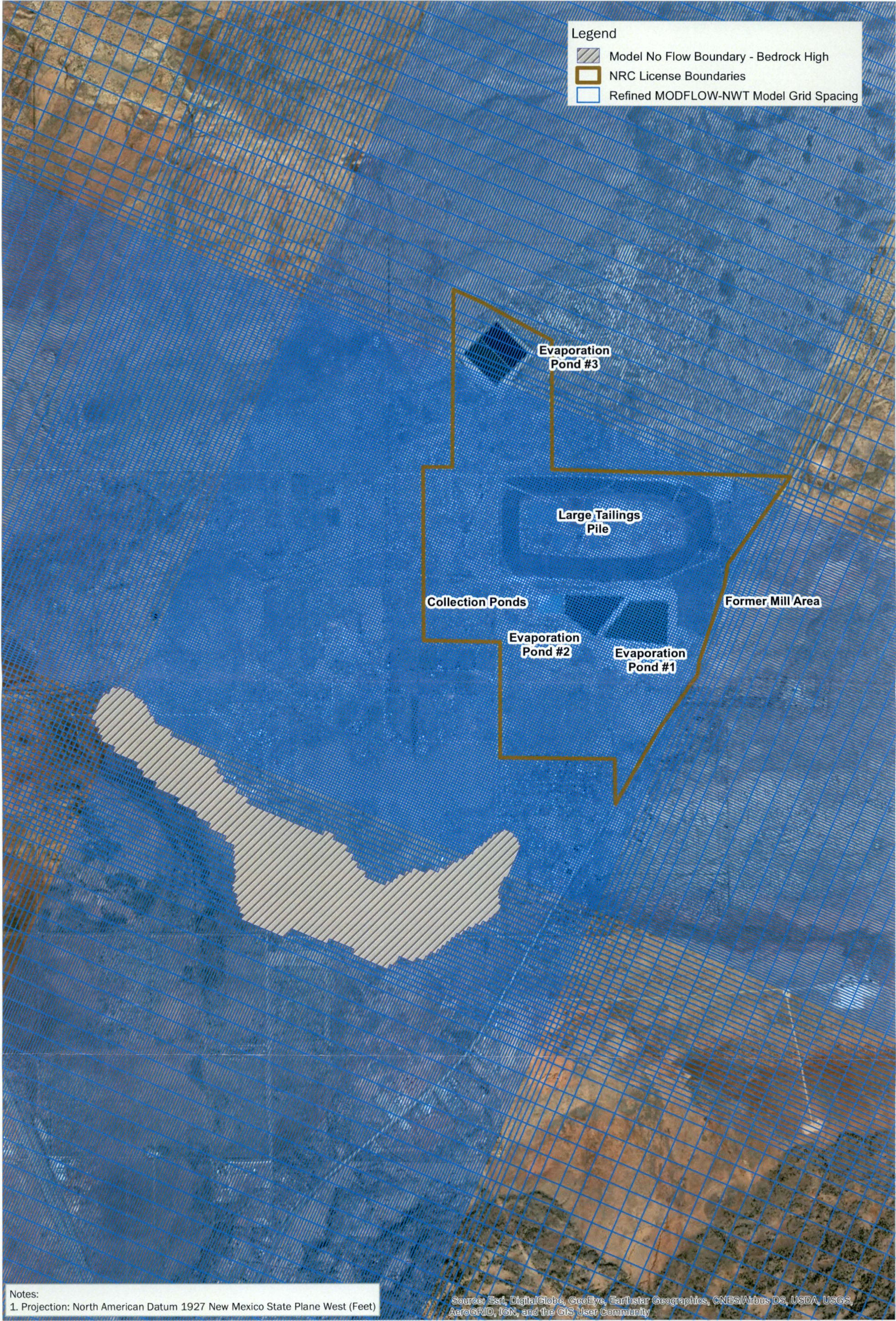


Figure 3-1
GRP Model Extent -
Active Model Domain



Notes:
1. Projection: North American Datum 1927 New Mexico State Plane West (Feet)

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

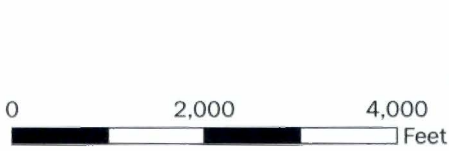
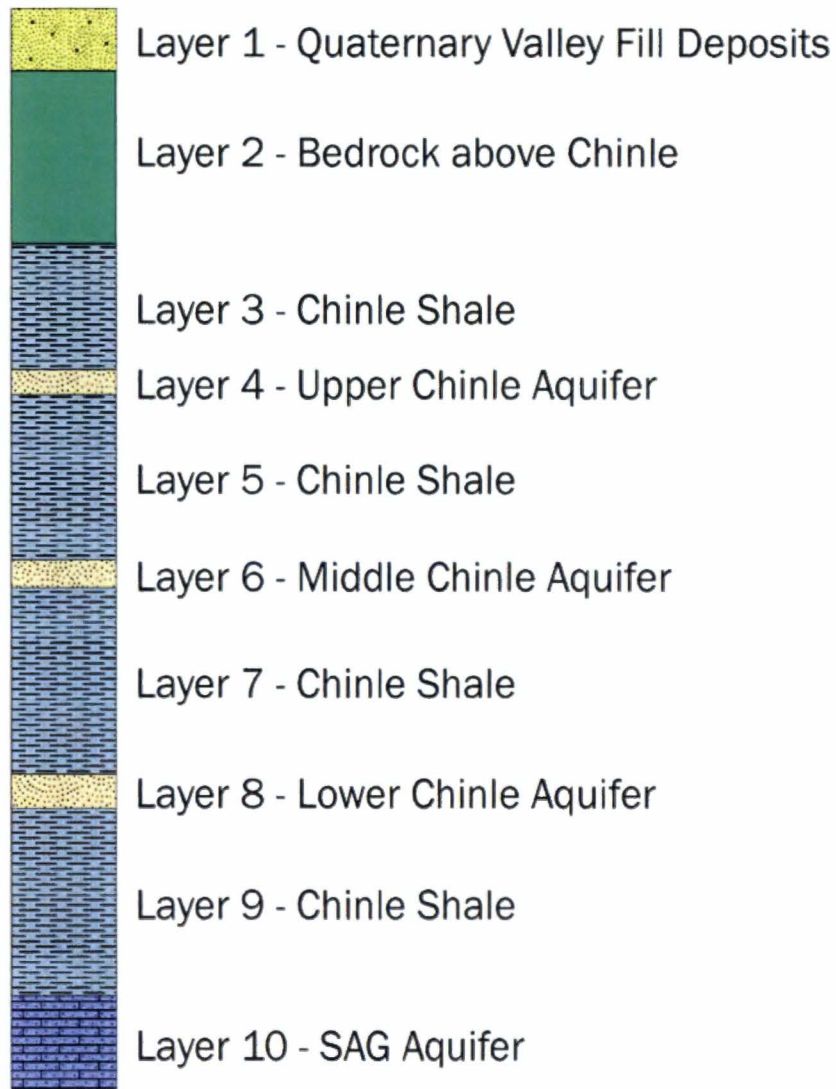
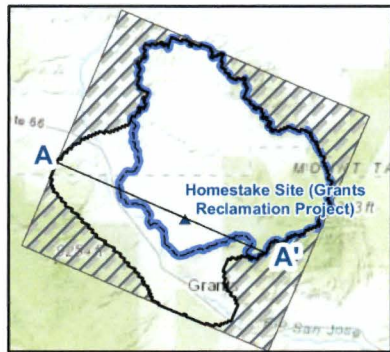
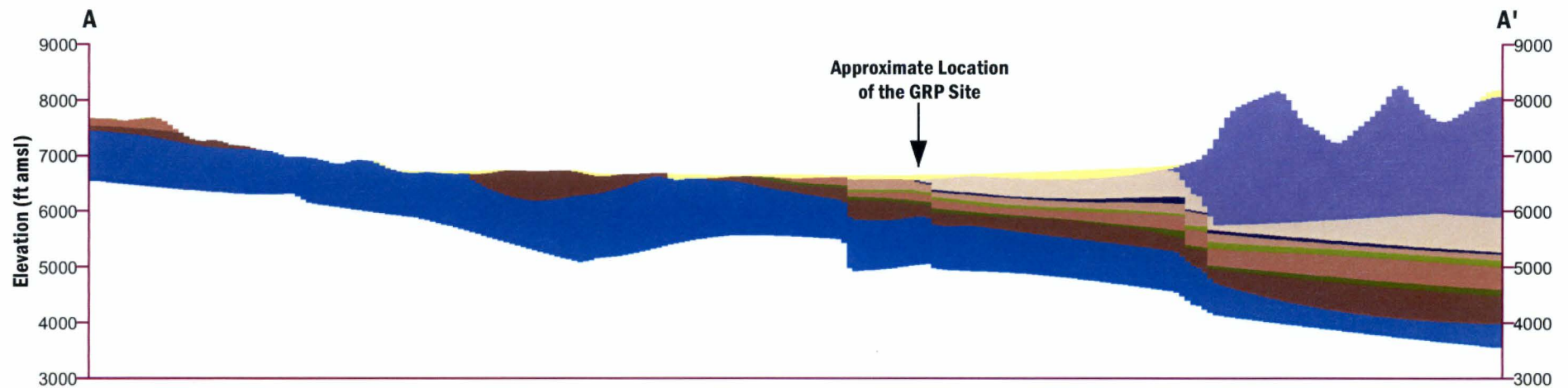


Figure 3-2
Area of High Grid Resolution
within GRP Site Area



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Figure 3-3
**GRP Model Layering Stratigraphic
Column**



Legend

- | | |
|--------------------------------------|--|
| Layer 1 - Alluvium | Layer 6 - Middle Chinle Aquifer |
| Layer 2 - Bedrock Above Chinle Group | Layer 7 - Middle Chinle Shale |
| Layer 3 - Upper Chinle Shale | Layer 8 - Lower Chinle Aquifer |
| Layer 4 - Upper Chinle Aquifer | Layer 9 - Lower Chinle Shale |
| Layer 5 - Middle Chinle Shale | Layer 10 - San Andres/Glorieta Aquifer |

Vertical Exaggeration = 5x



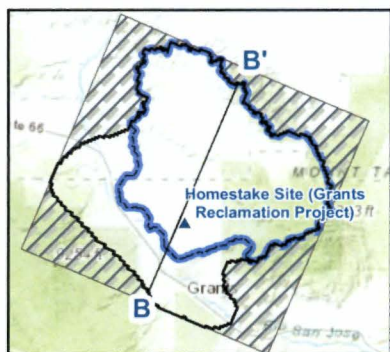
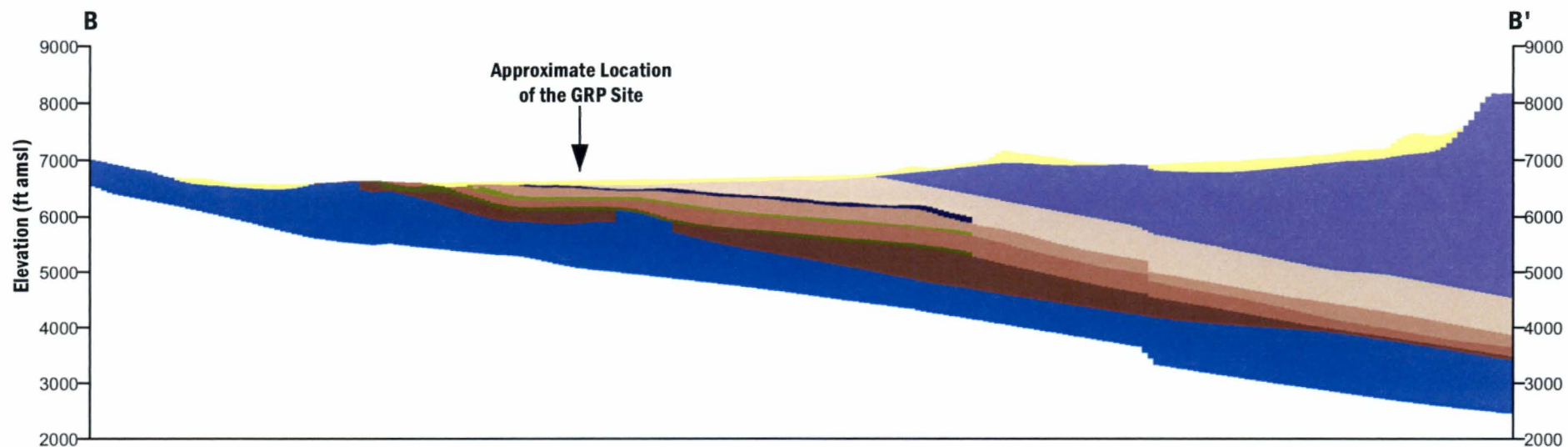
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0 2.5 5 Miles



Figure 3-4

MODFLOW-NWT Hydrogeologic Cross
Section A-A' Through the GRP Site



Legend

- | | |
|--------------------------------------|--|
| Layer 1 - Alluvium | Layer 6 - Middle Chinle Aquifer |
| Layer 2 - Bedrock Above Chinle Group | Layer 7 - Middle Chinle Shale |
| Layer 3 - Upper Chinle Shale | Layer 8 - Lower Chinle Aquifer |
| Layer 4 - Upper Chinle Aquifer | Layer 9 - Lower Chinle Shale |
| Layer 5 - Middle Chinle Shale | Layer 10 - San Andres/Glorieta Aquifer |

Vertical Exaggeration = 5x



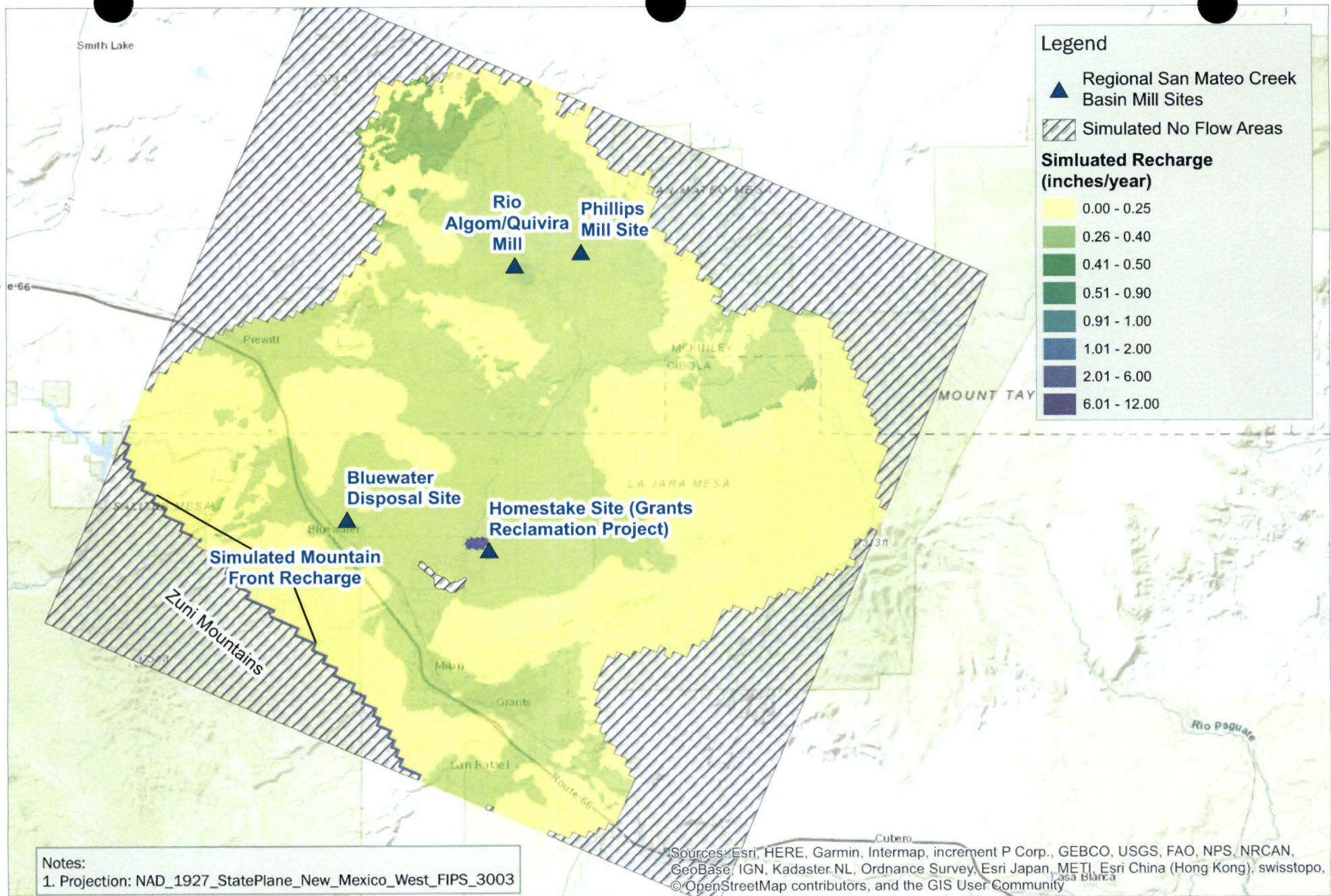
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Figure 3-5

MODFLOW-NWT Hydrogeologic Cross
Section B-B' Through the GRP Site

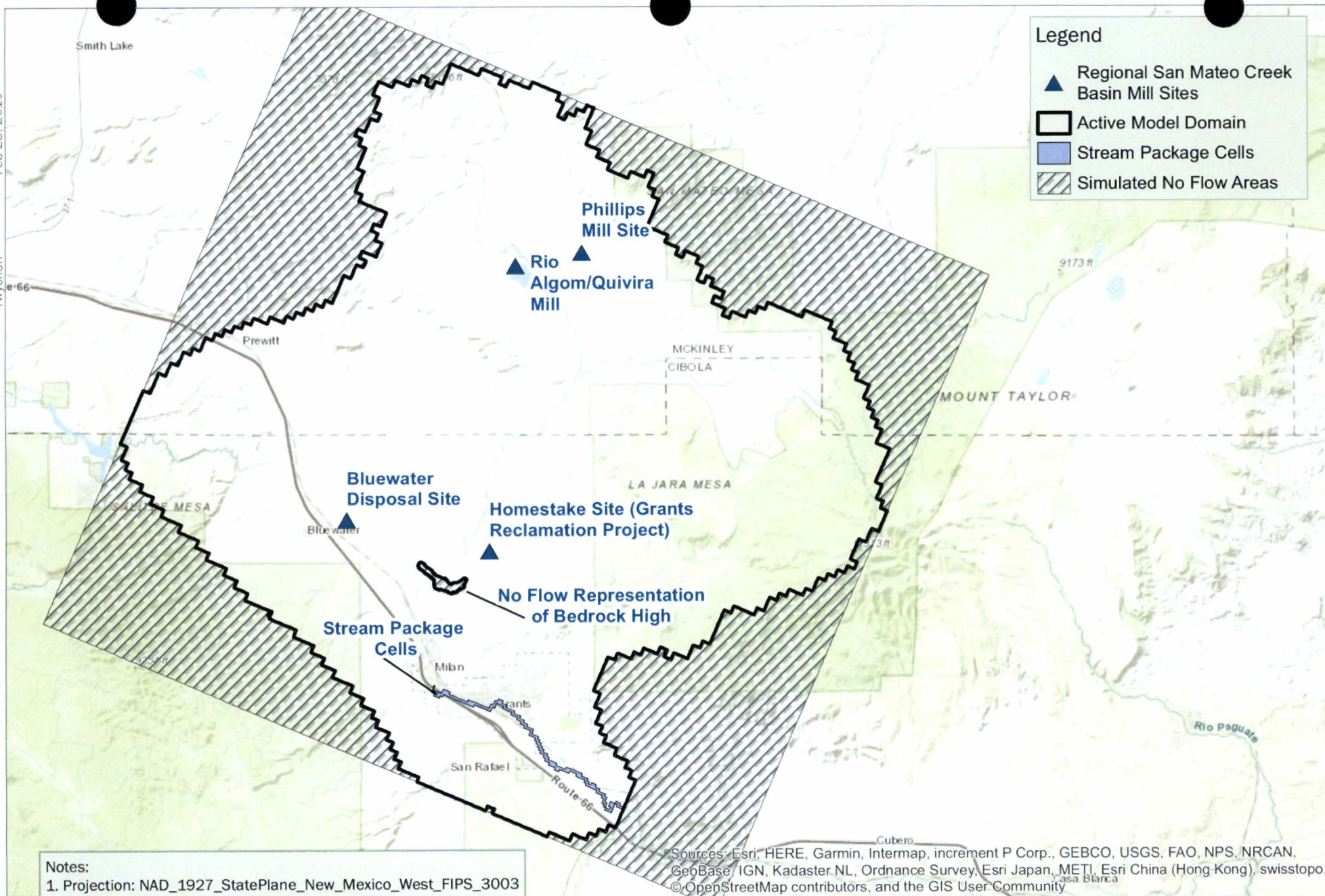


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0 2.5 5
Miles



Figure 3-6
Simulated Annual Recharge Rates



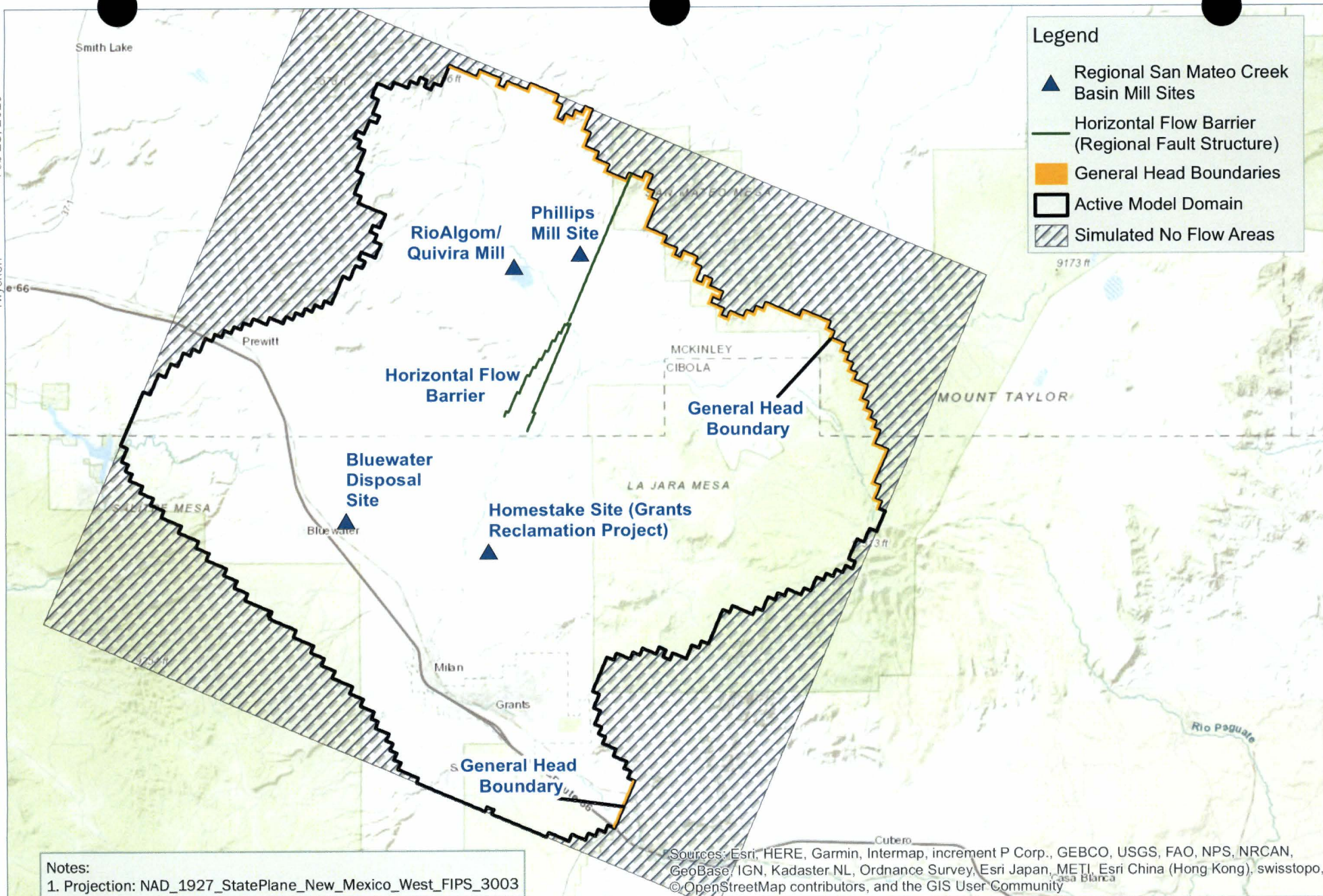
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0 2.5 5
 Miles



Figure 3-7

Layer 1 (Alluvial Aquifer) Boundary Conditions



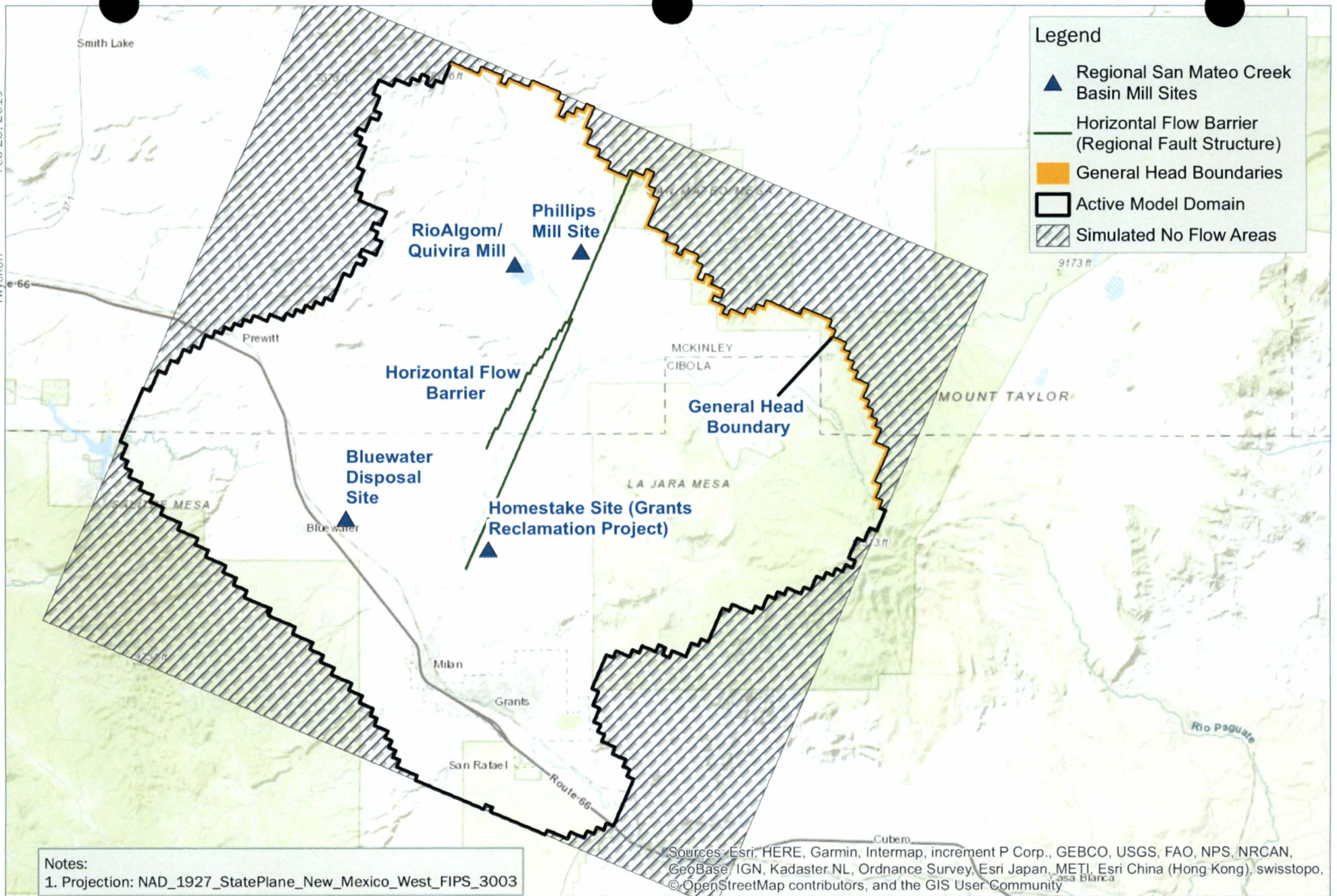
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0 2.5 5
Miles



Figure 3-8

Layer 2 (Bedrock Above Chinle Group)
Boundary Conditions



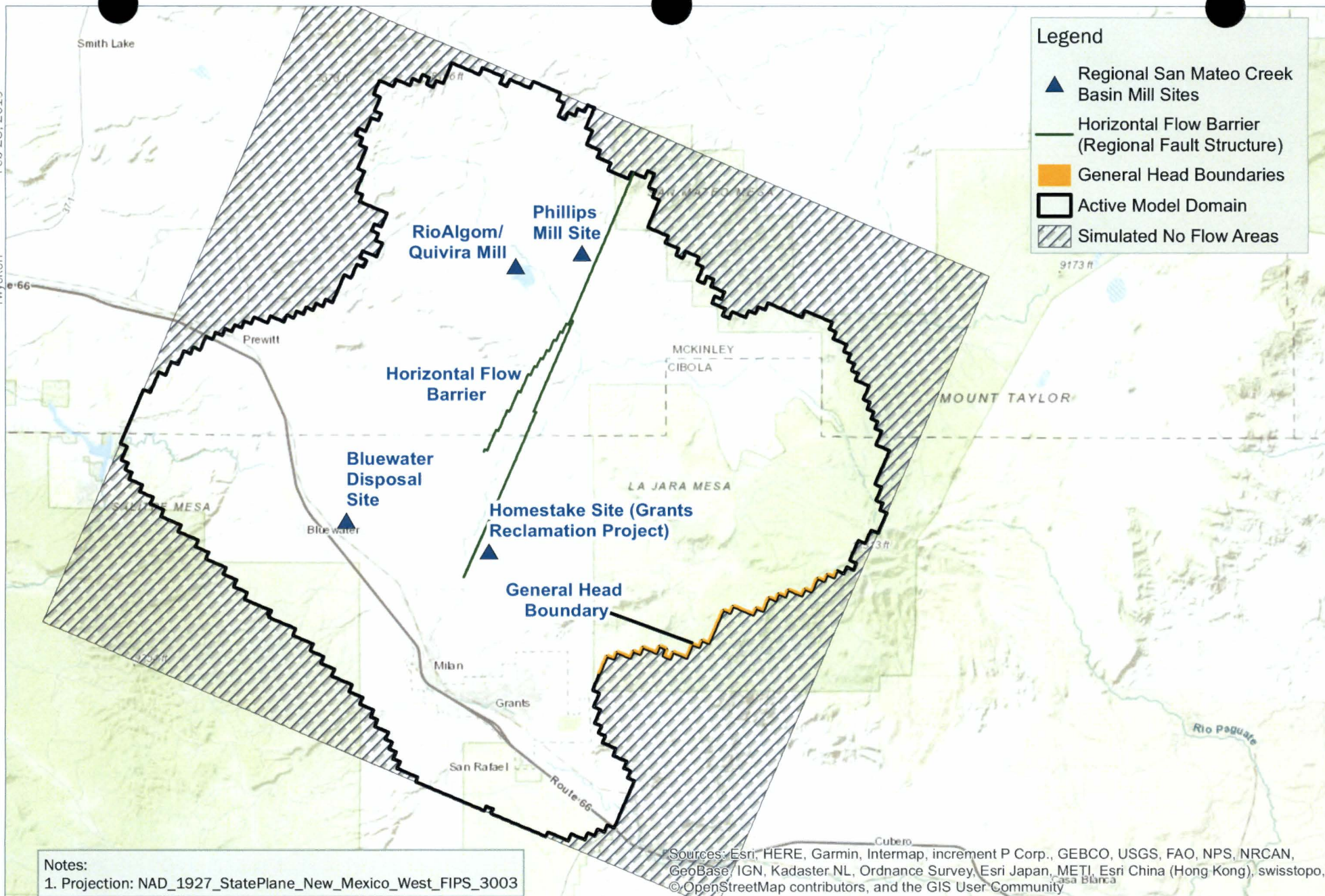
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0 2.5 5
Miles



Figure 3-9

Layer 3 (Upper Chinle Shale)
Boundary Conditions

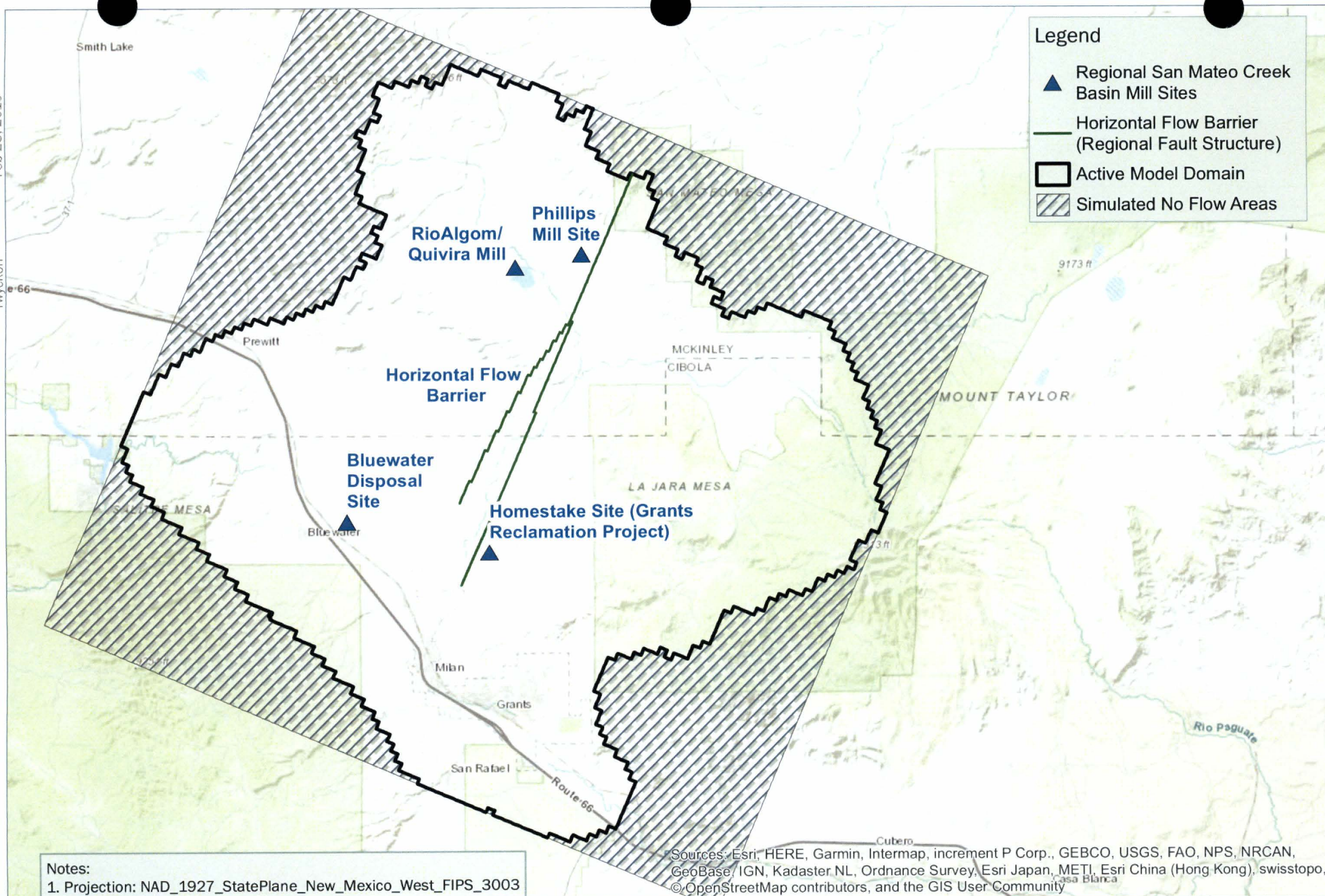


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0 2.5 5
 Miles



Figure 3-10
Layer 4 (Upper Chinle Aquifer)
Boundary Conditions

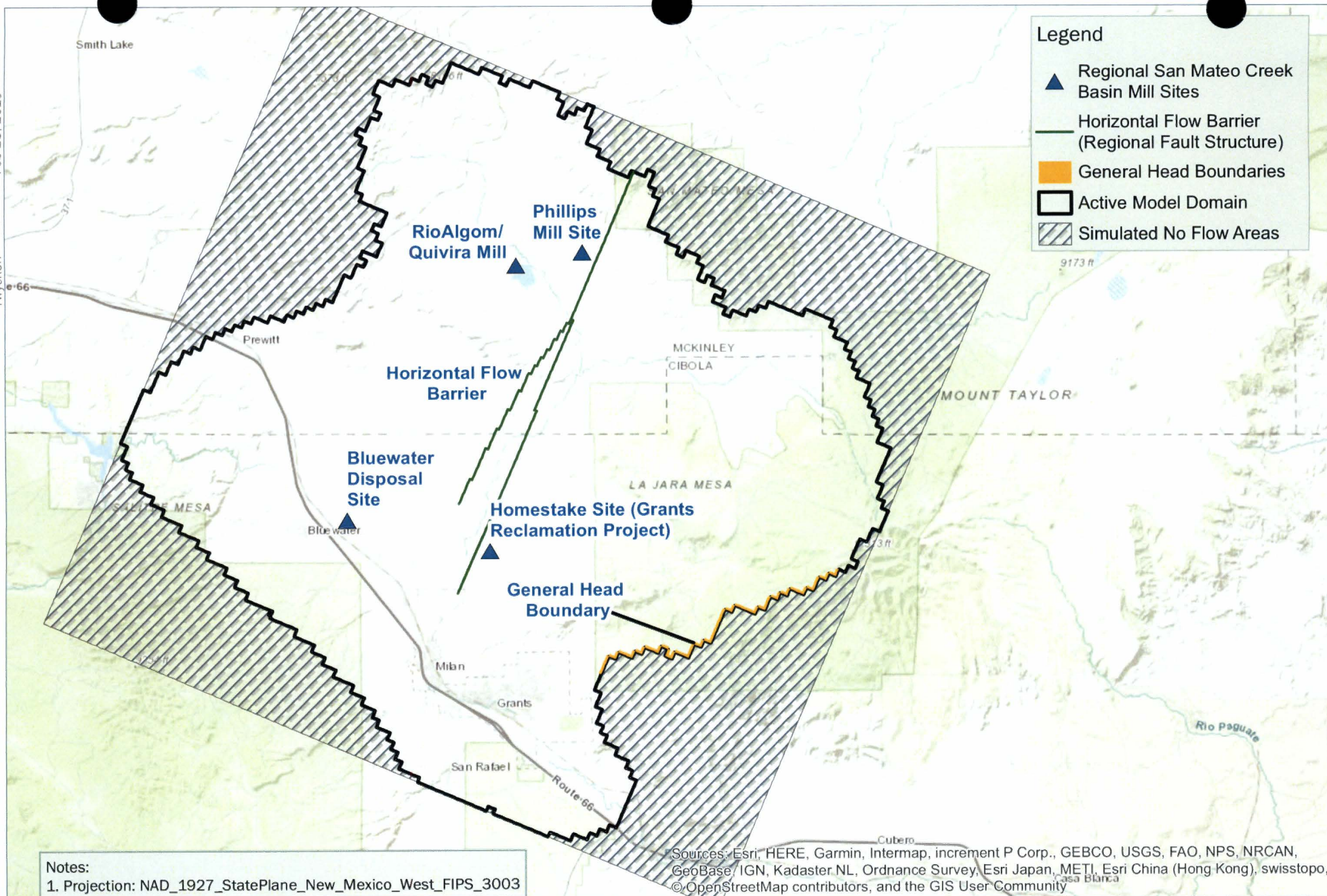


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0 2.5 5
Miles



Figure 3-11
Layer 5 (Middle Chinle Shale)
Boundary Conditions



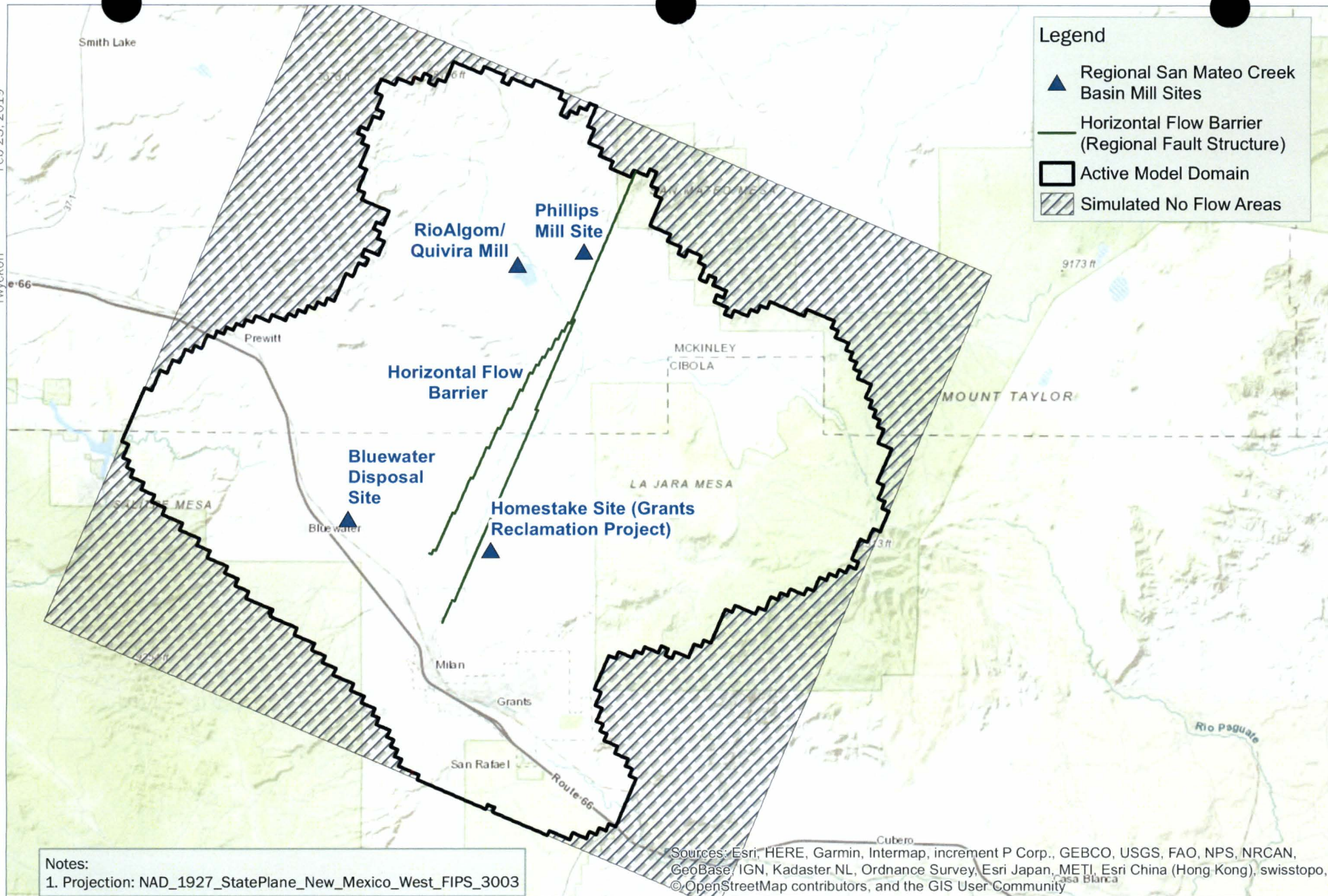
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0 2.5 5
Miles



Figure 3-12

Layer 6 (Upper Chinle Aquifer)
Boundary Conditions

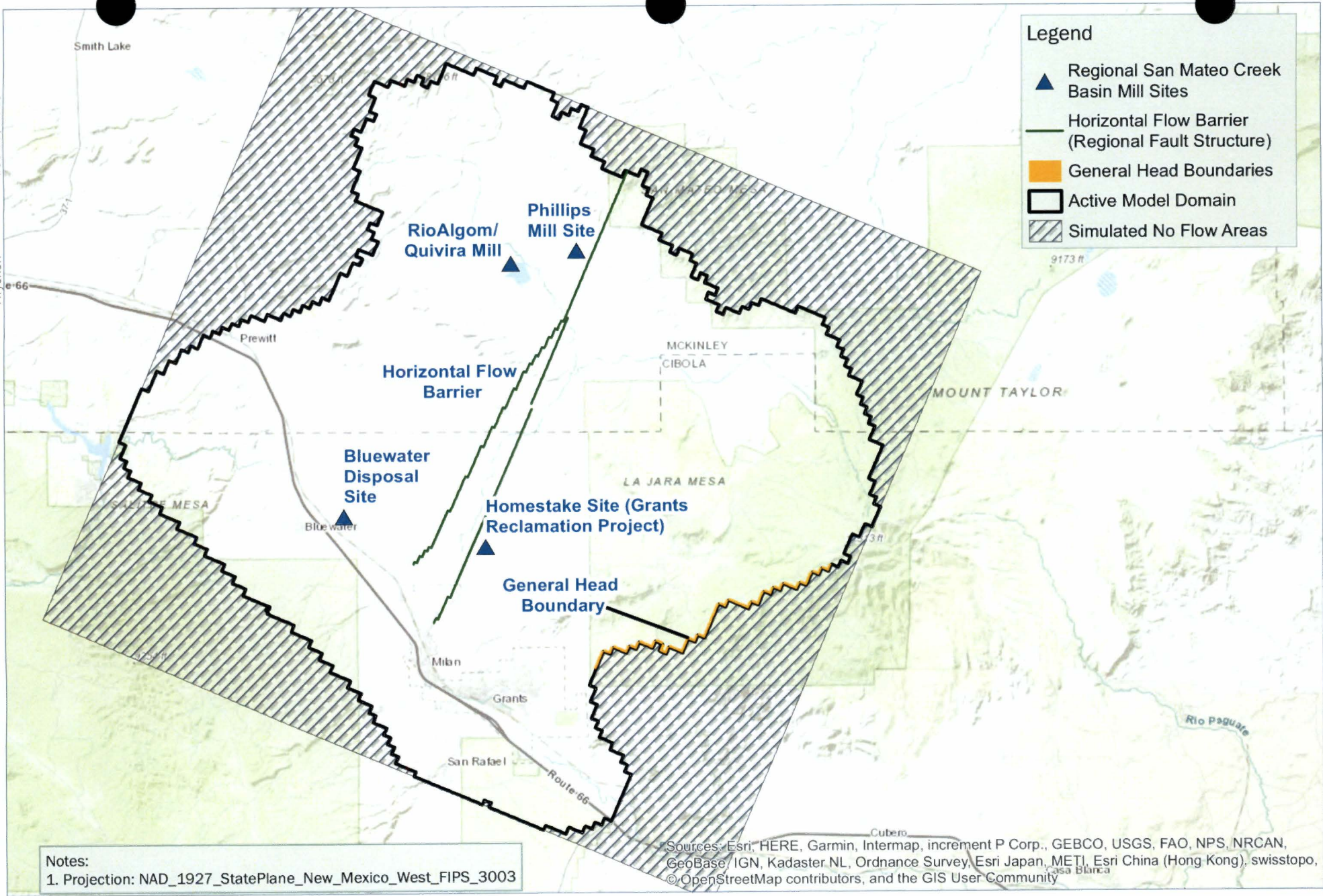


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0 2.5 5
Miles



Figure 3-13
Layer 7 (Middle Chinle Shale)
Boundary Conditions



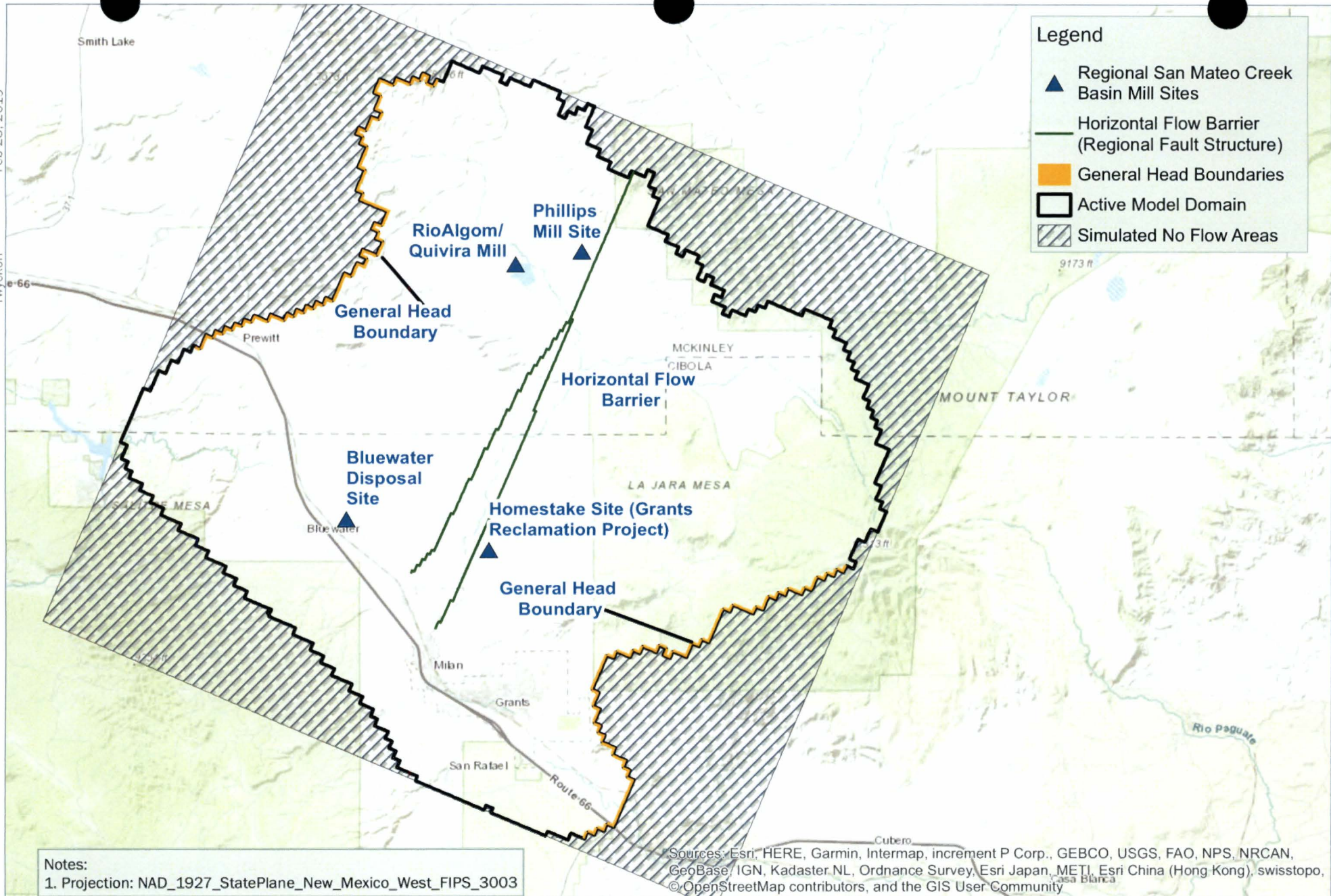
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0 2.5 5
Miles



Figure 3-14

Layer 8 (Lower Chinle Aquifer)
Boundary Conditions

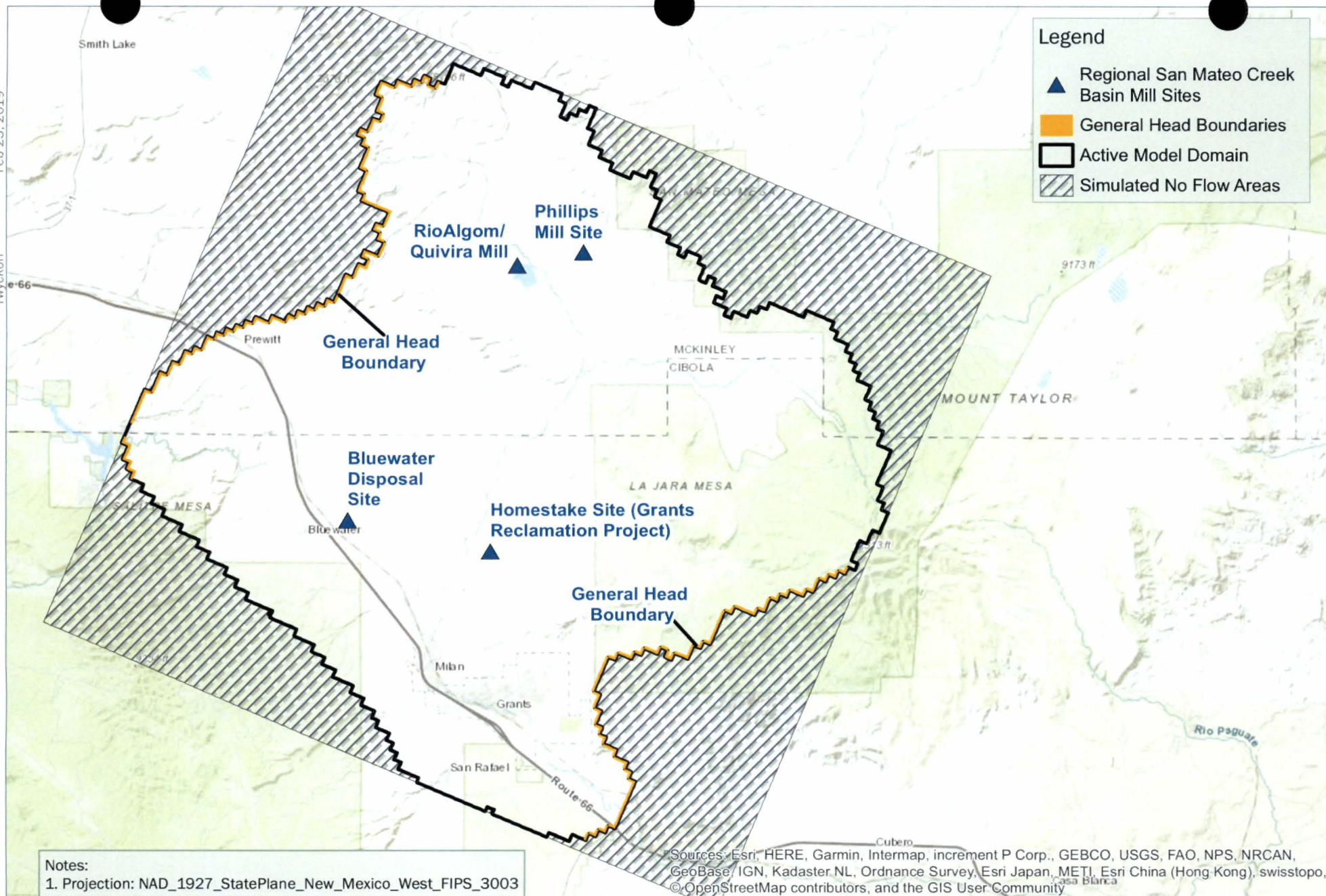


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0 2.5 5
Miles



Figure 3-15
Layer 9 (Lower Chinle Shale)
Boundary Conditions

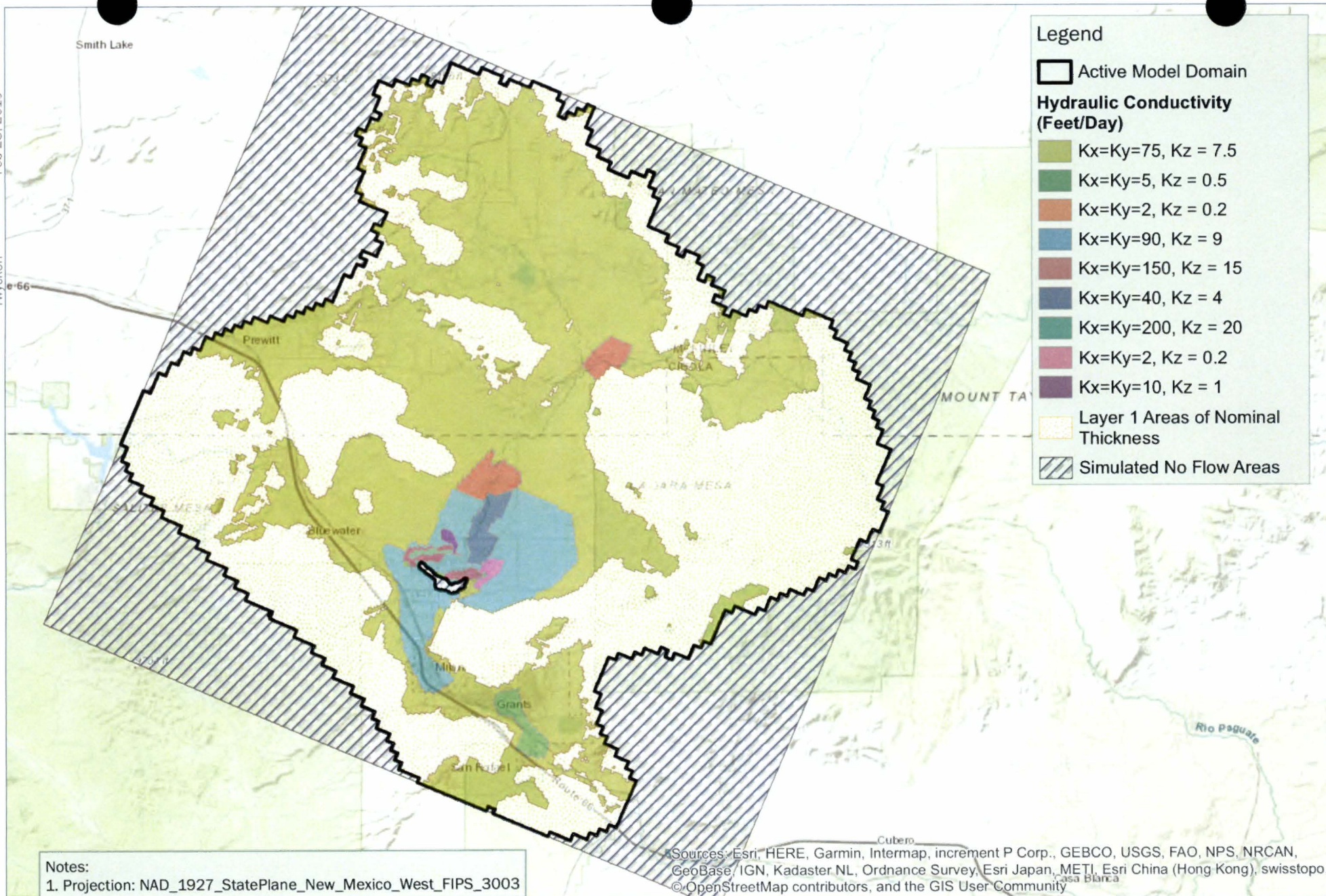


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0 2.5 5
 Miles



Figure 3-16
Layer 10 (San Andres/Glorieta Aquifer)
Boundary Conditions



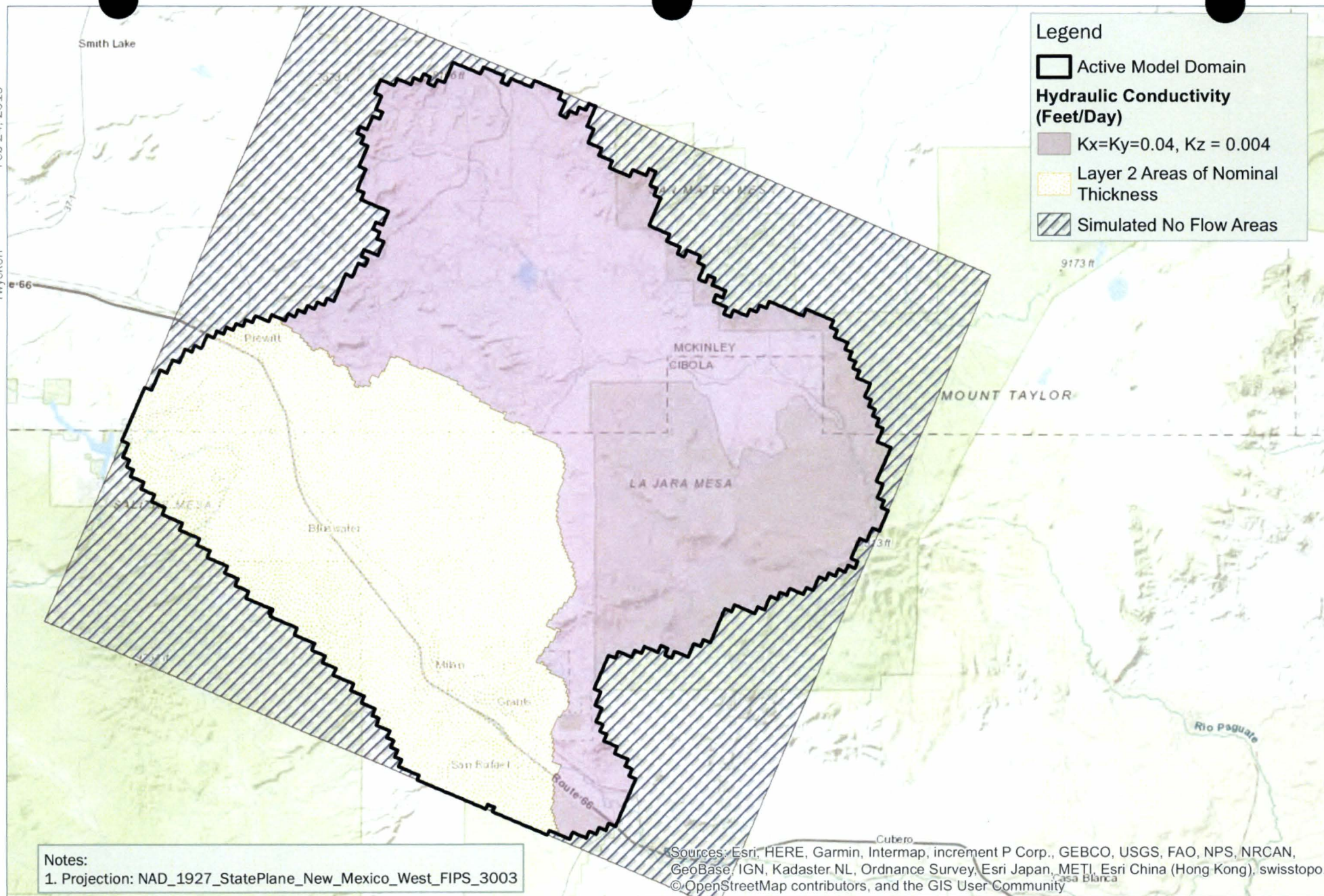
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0 2.5 5
Miles



Figure 3-17

Layer 1 (Alluvial Aquifer) Hydraulic Conductivity



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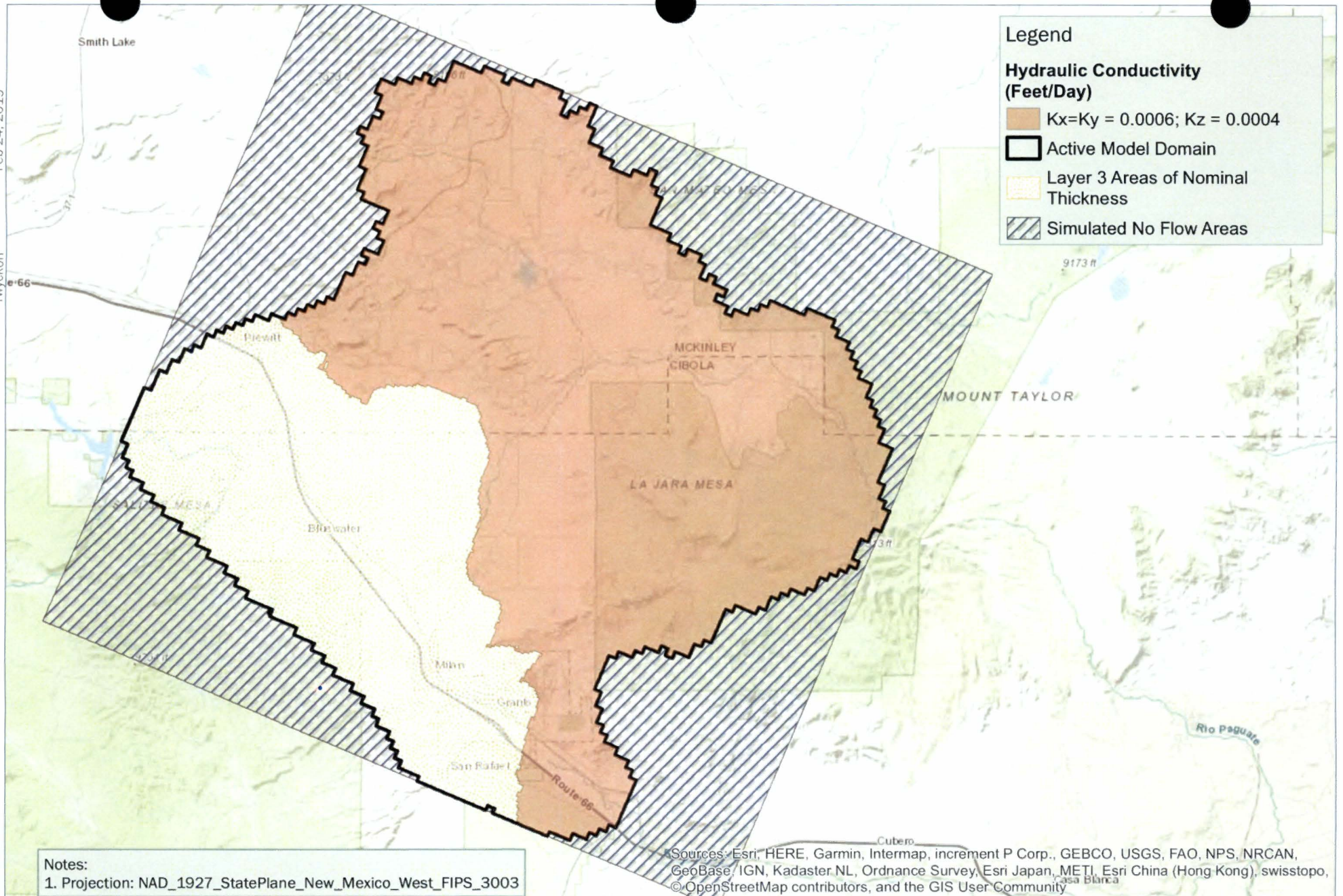
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Miles



Figure 3-18

Layer 2 (Bedrock above the
Chinle Group) Hydraulic Conductivity

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Feb 24, 2019
rwycckoff

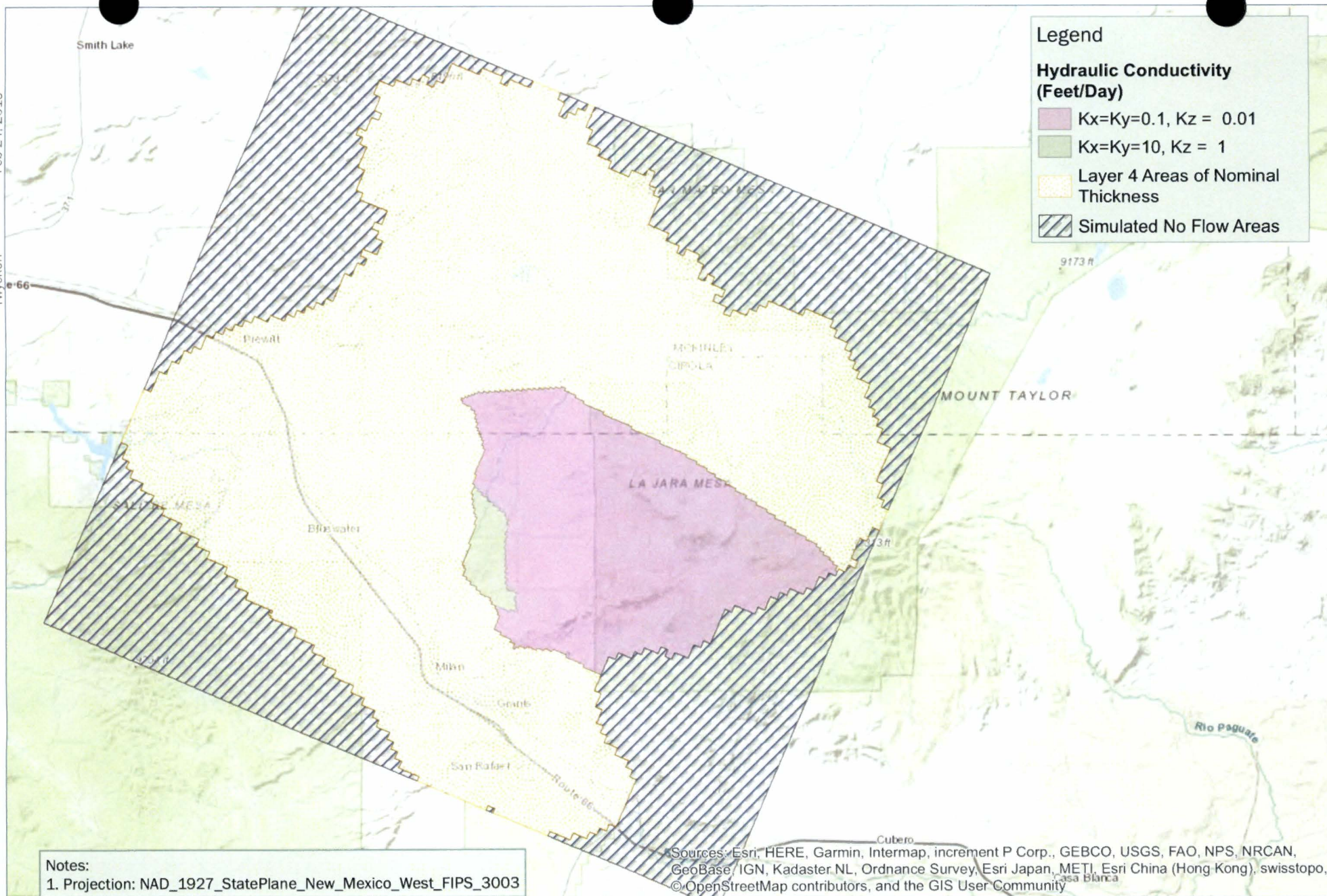


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0 2.5 5
Miles



Figure 3-19
Layer 3 (Upper Chinle Shale)
Hydraulic Conductivity



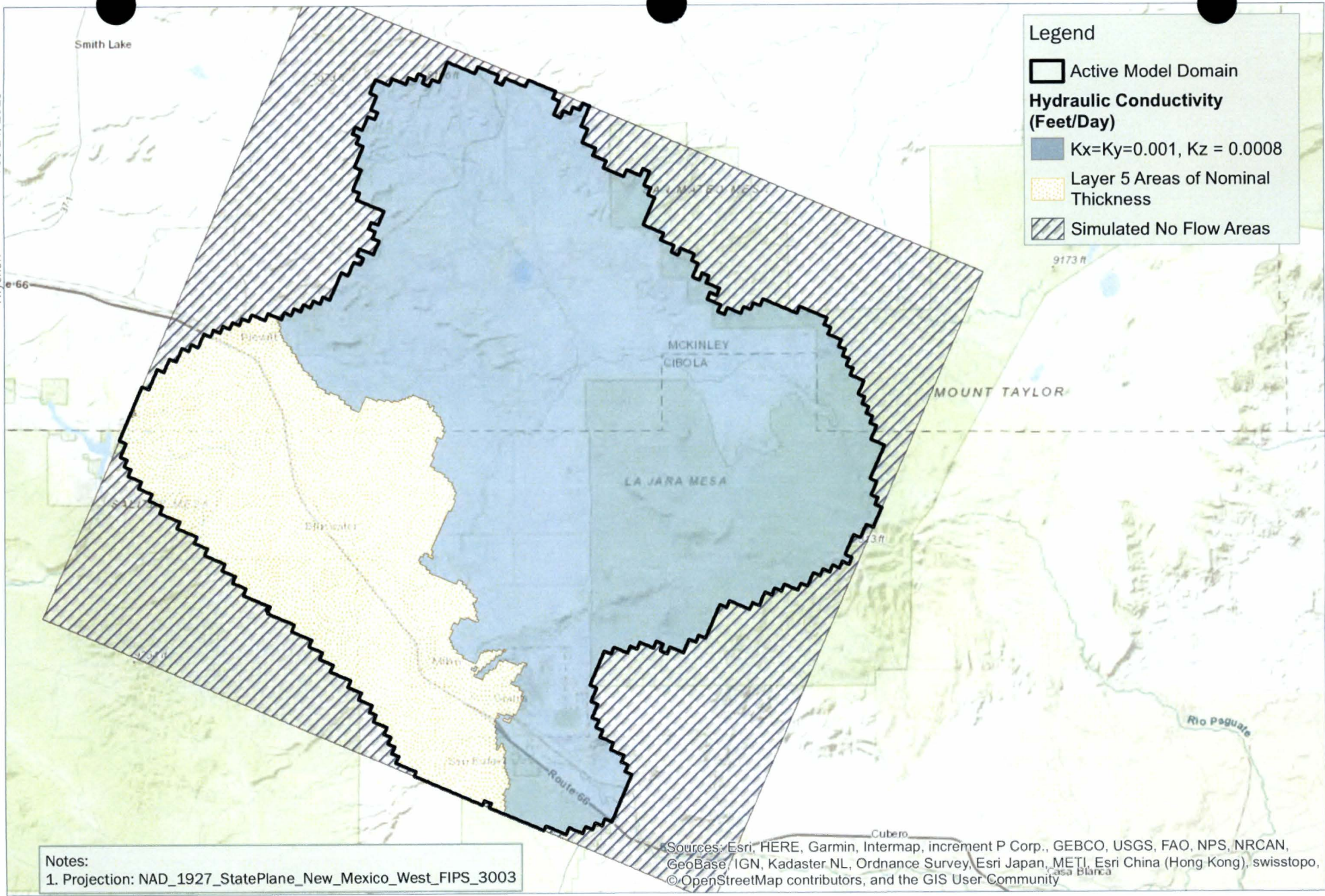
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0 2.5 5
Miles



Figure 3-20

Layer 4 (Upper Chinle Aquifer)
Hydraulic Conductivity



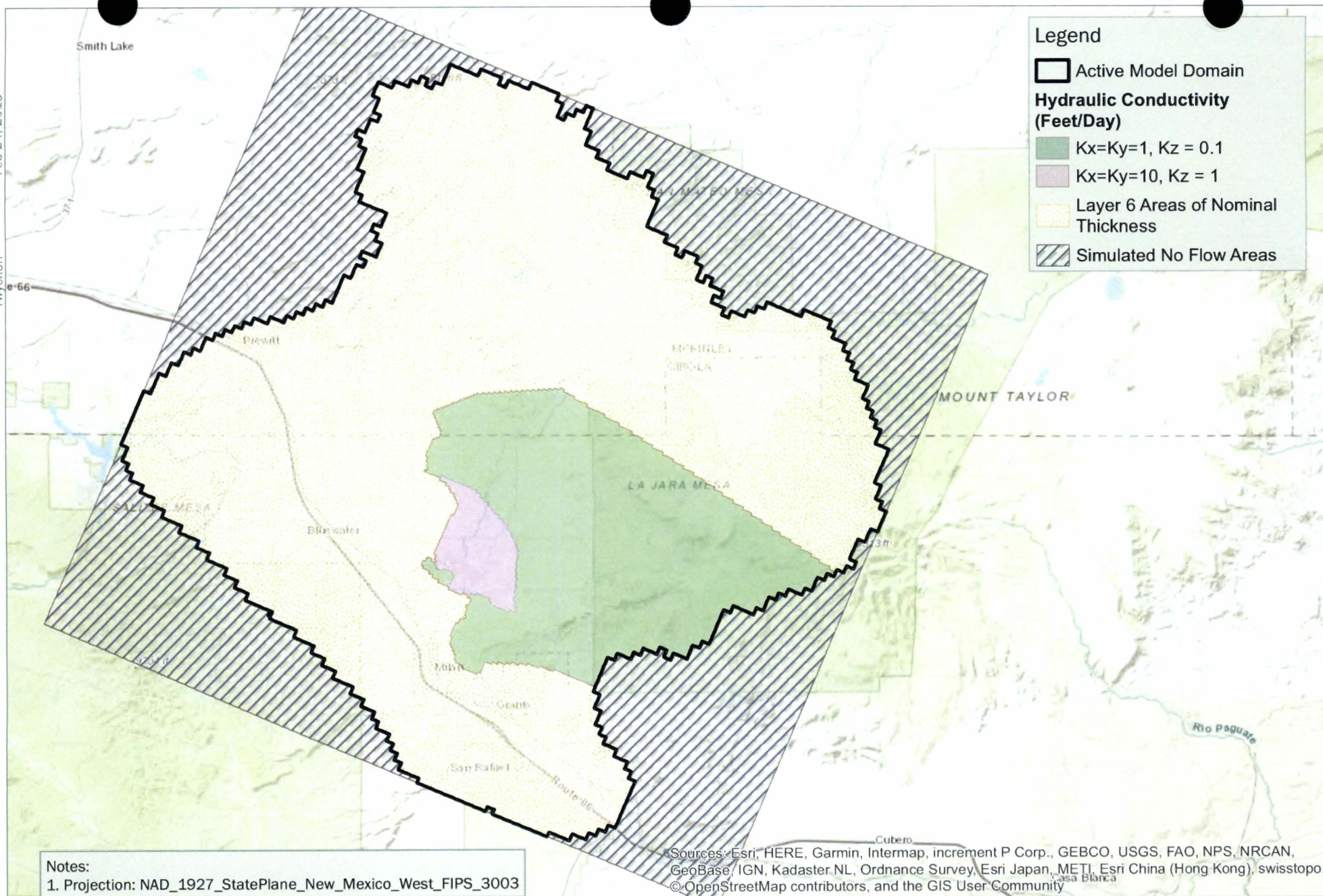
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0 2.5 5
Miles



Figure 3-21

Layer 5 (Middle Chinle Shale)
Hydraulic Conductivity



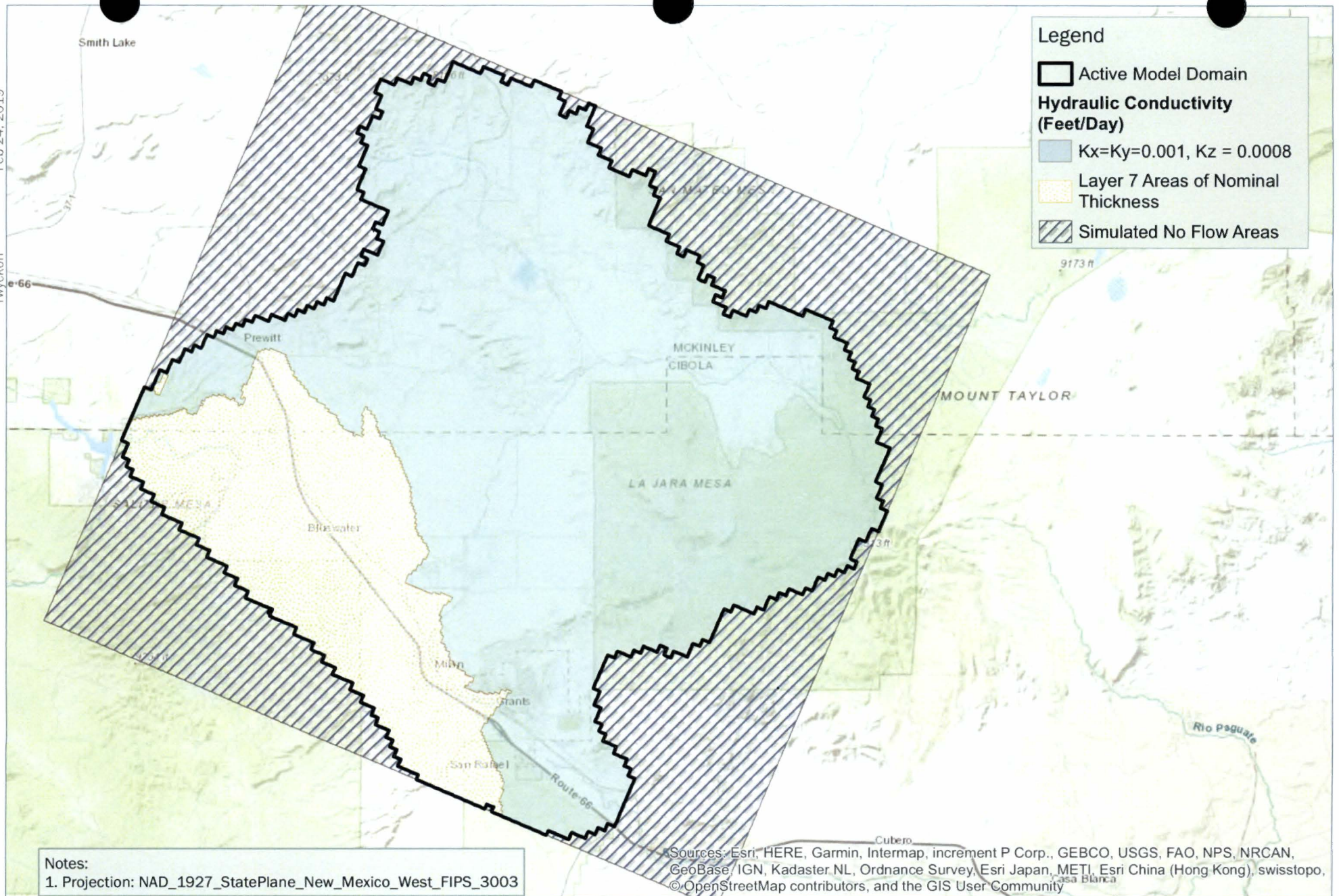
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0 2.5 5
Miles



Figure 3-22

Layer 6 (Middle Chinle Aquifer)
Hydraulic Conductivity



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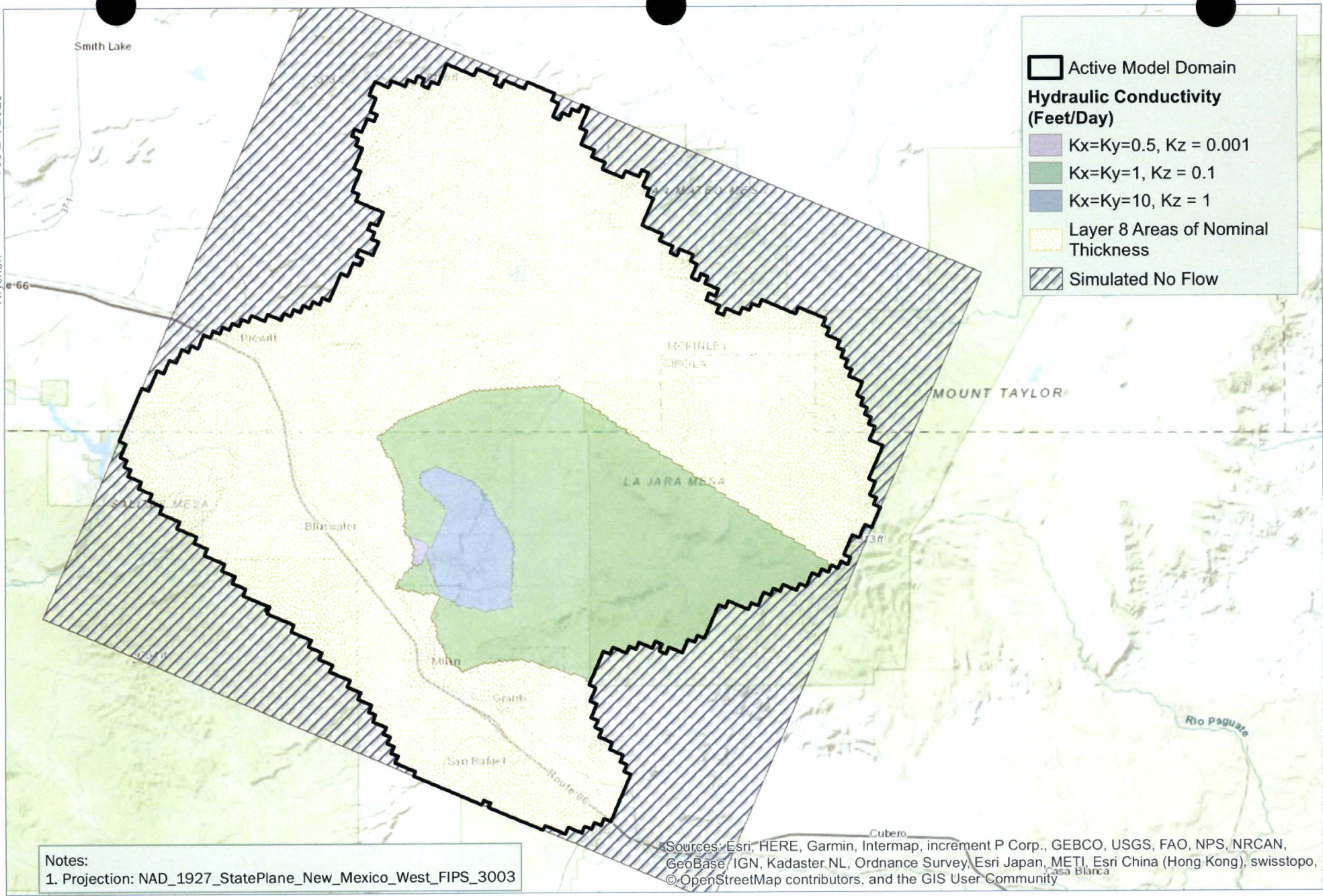
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Figure 3-23

Layer 7 (Middle Chinle Shale)
Hydraulic Conductivity

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Feb 24, 2019



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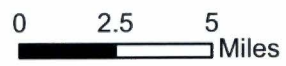
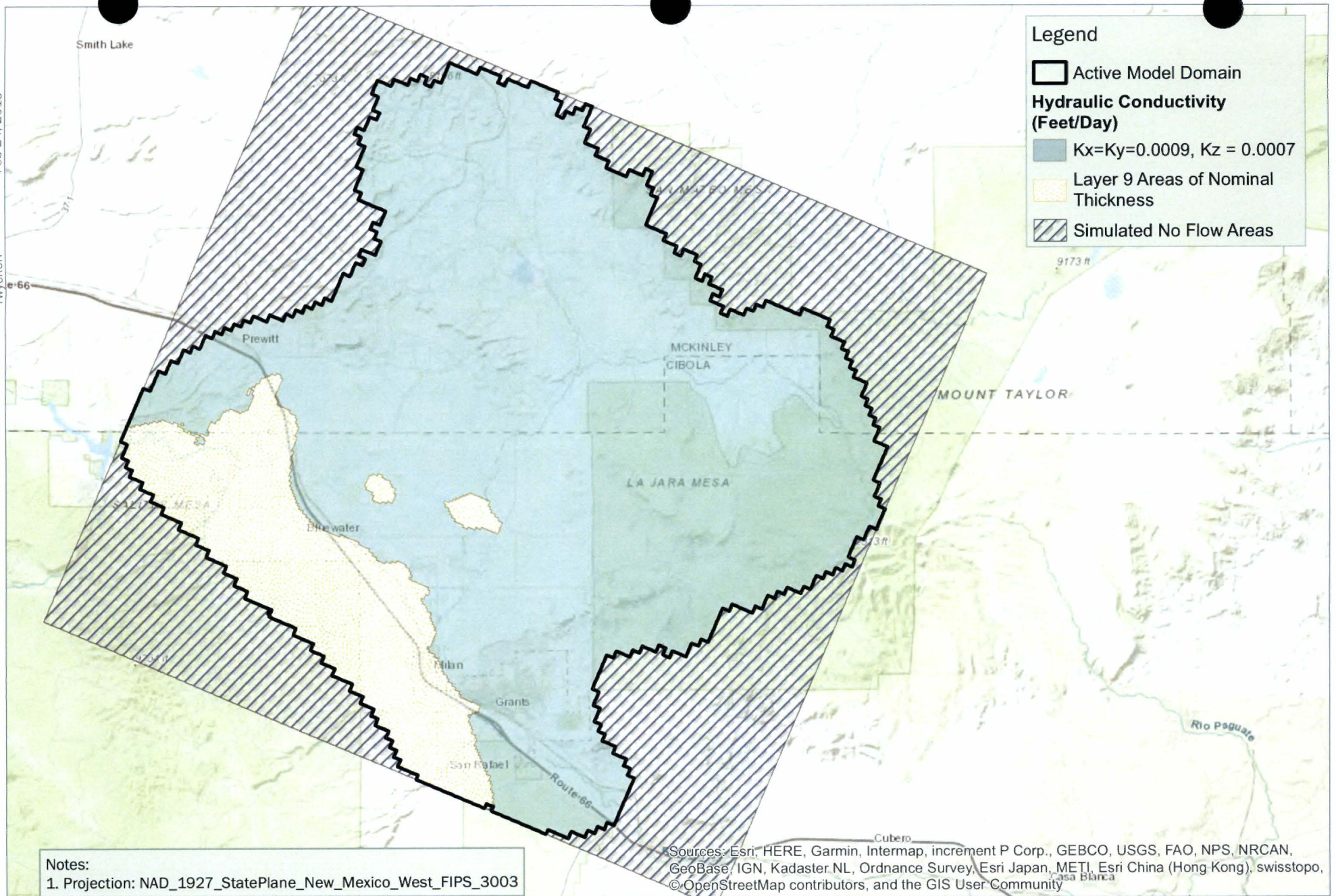


Figure 3-24
Layer 8 (Lower Chinle Aquifer)
Hydraulic Conductivity



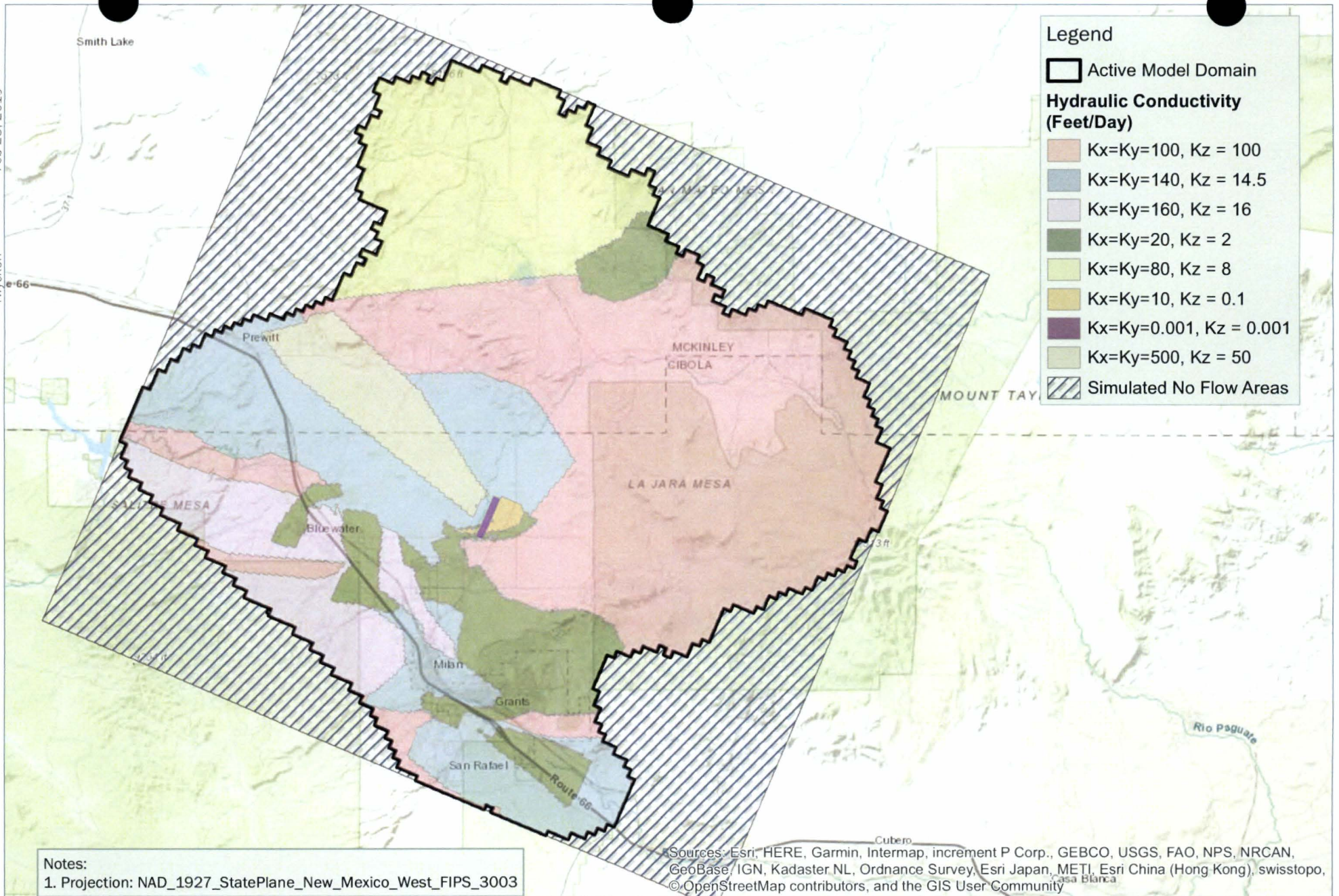
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0 2.5 5
Miles



Figure 3-25

Layer 9 (Lower Chinle Shale)
Hydraulic Conductivity



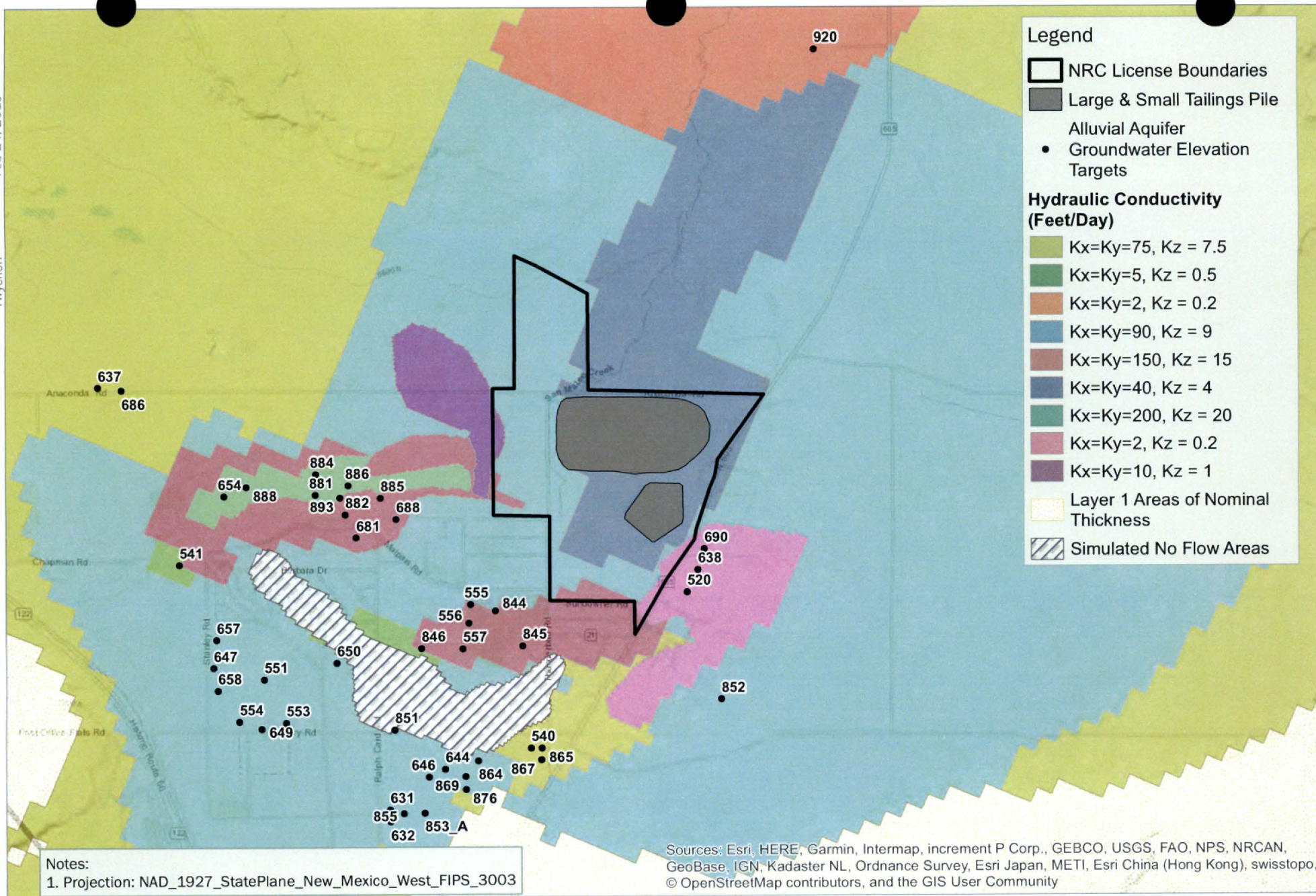
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0 2.5 5
 Miles



Figure 3-26

Layer 10 (San Andres/Glorieta Aquifer)
Hydraulic Conductivity



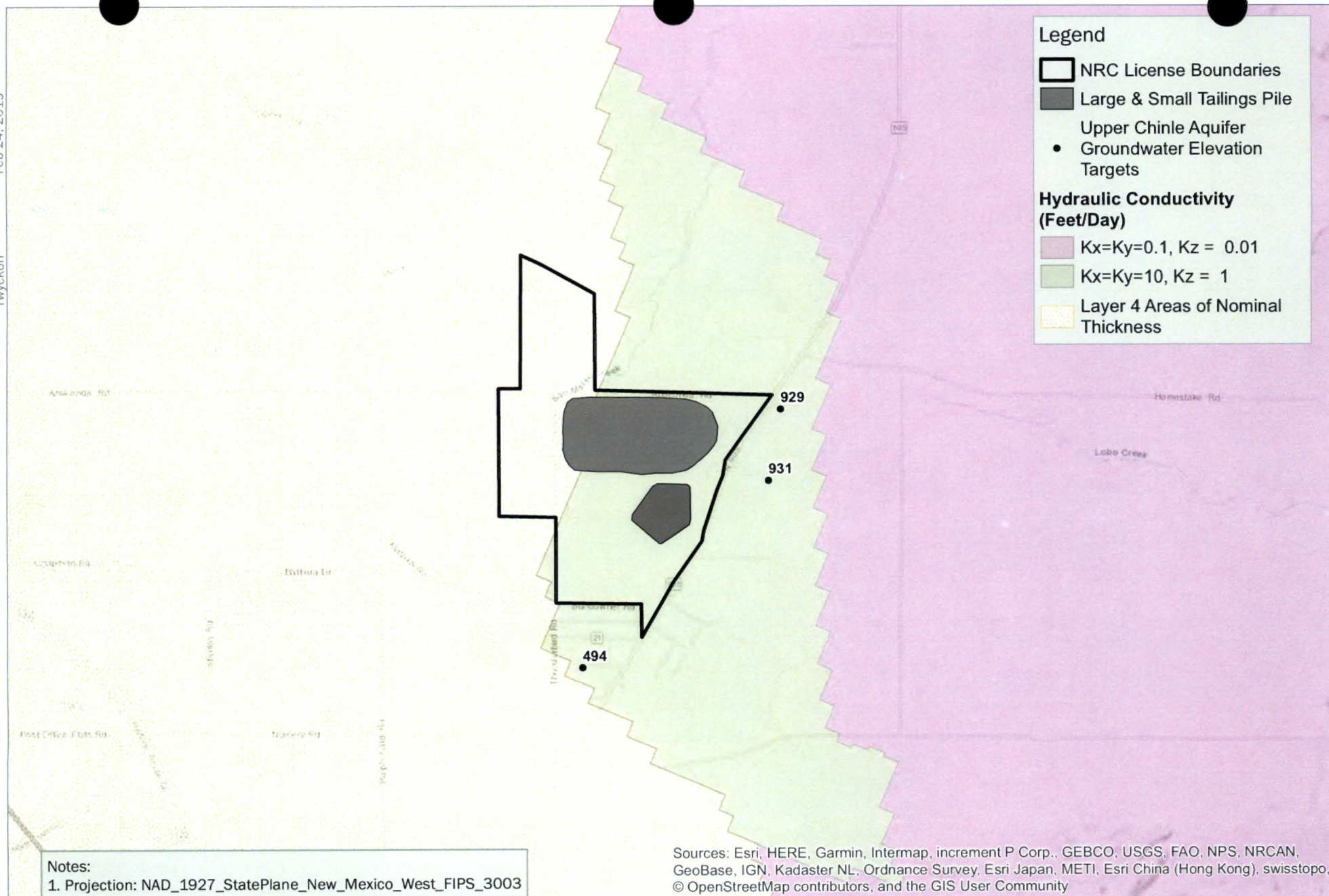
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0 2,000 4,000
 Feet



Figure 4-1

Layer 1 (Alluvial Aquifer) Hydraulic Conductivity and Groundwater Elevation Targets



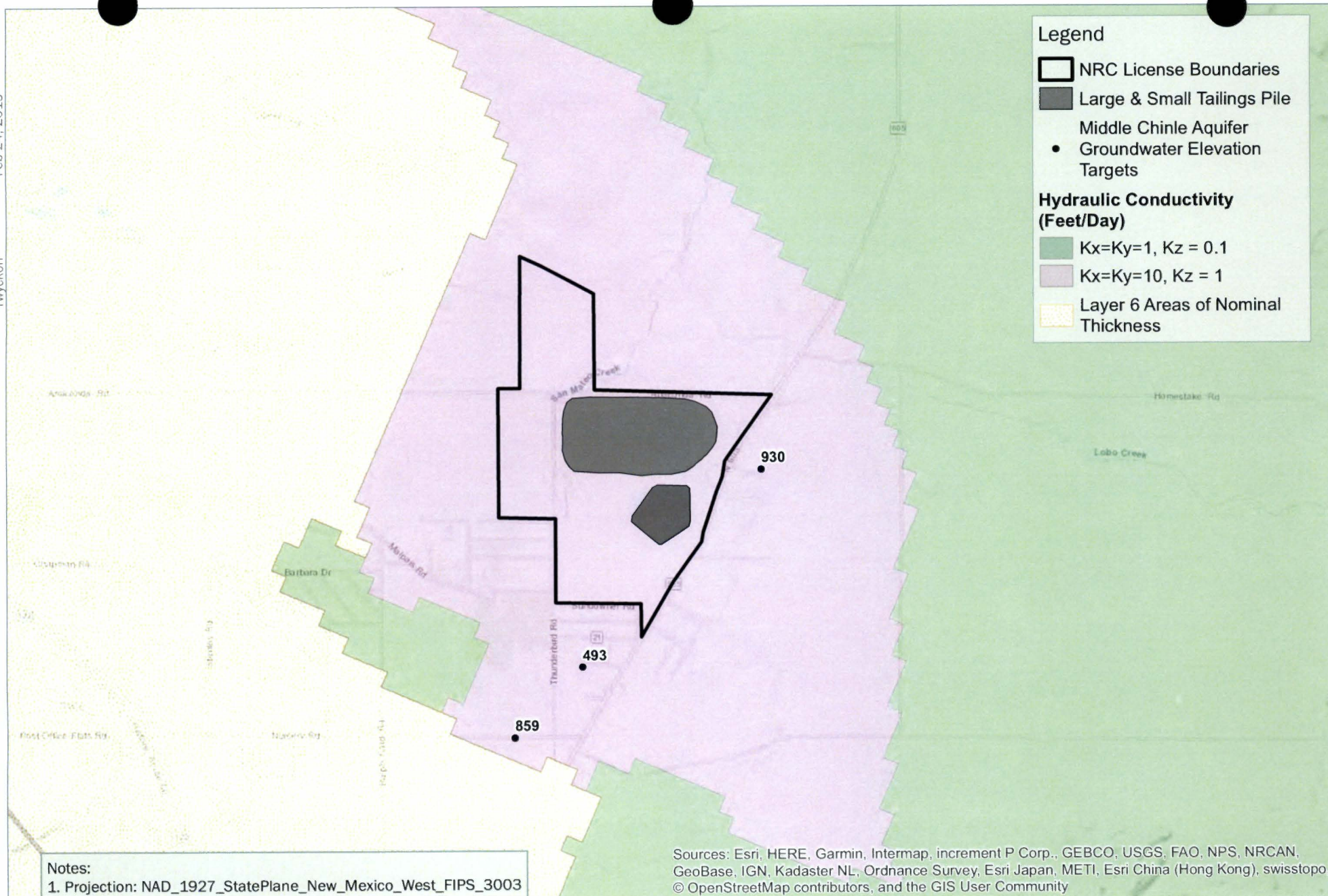
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0 2,000 4,000
 Feet



Figure 4-2

Layer 4 (Upper Chinle Aquifer)
Hydraulic Conductivity and Groundwater
Elevation Targets



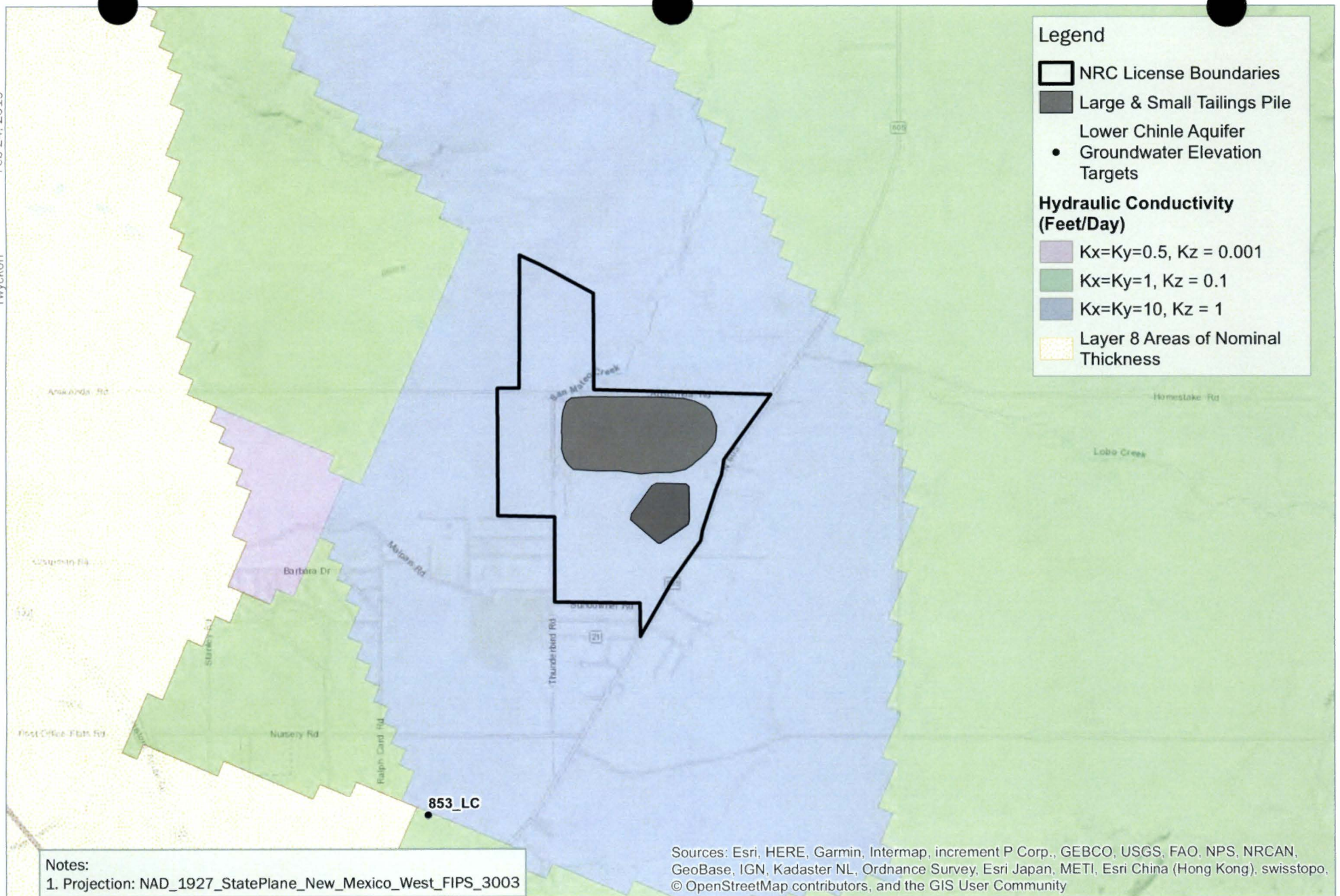
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0 2,000 4,000
 Feet



Figure 4-3

Layer 6 (Middle Chinle Aquifer)
Hydraulic Conductivity and Groundwater
Elevation Targets



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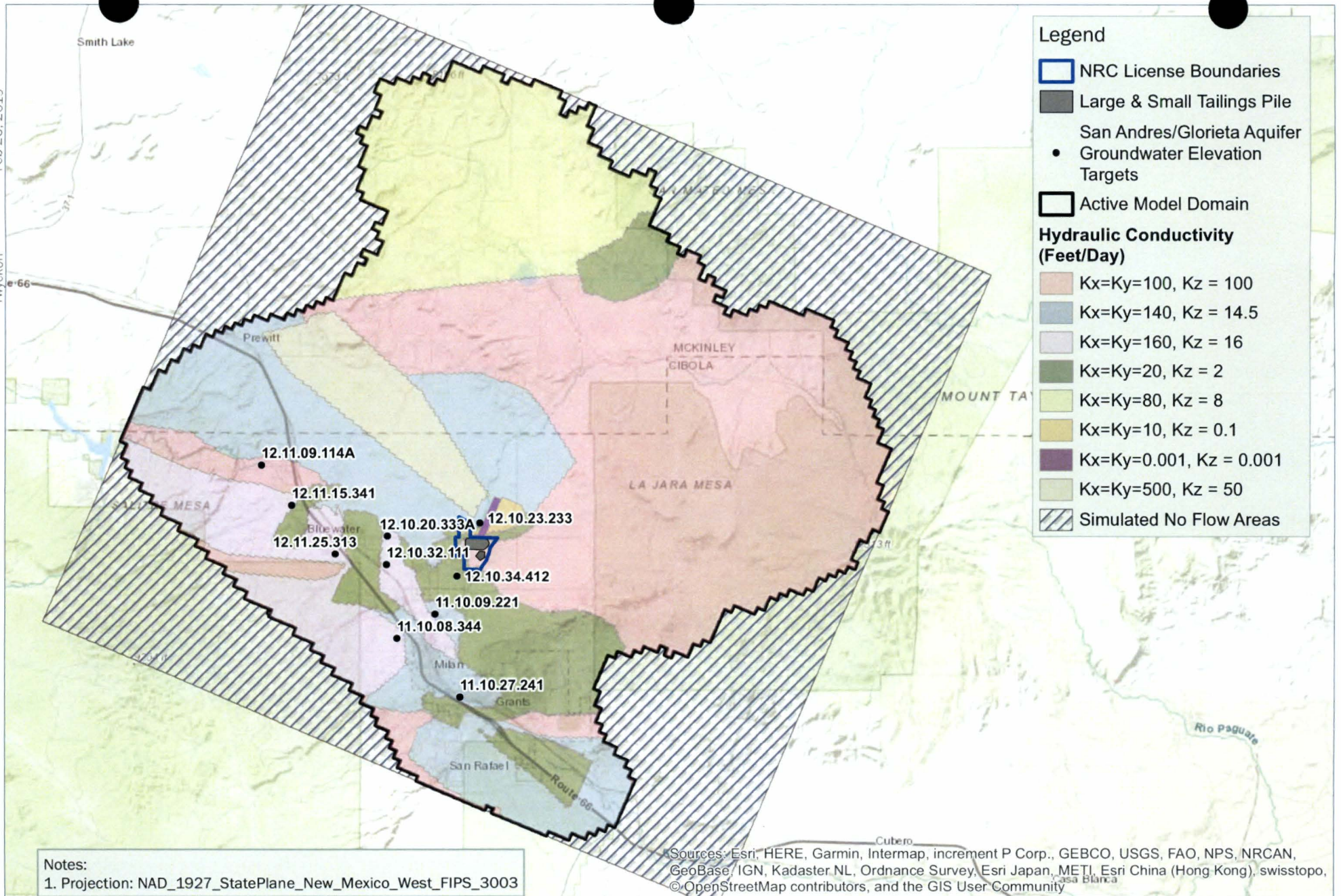
0 2,000 4,000
 Feet



Figure 4-4

Layer 8 (Lower Chinle Aquifer)
Hydraulic Conductivity and Groundwater
Elevation Targets

[BCDENFP01]: P:\Data\GEN\Barrick-Homestake\Grants Groundwater Model\GIS_SiteModel\Reporting\Figure4_5_Ly10_HydraulicAndTargs.mxd
Feb 26, 2019
rwyckoff



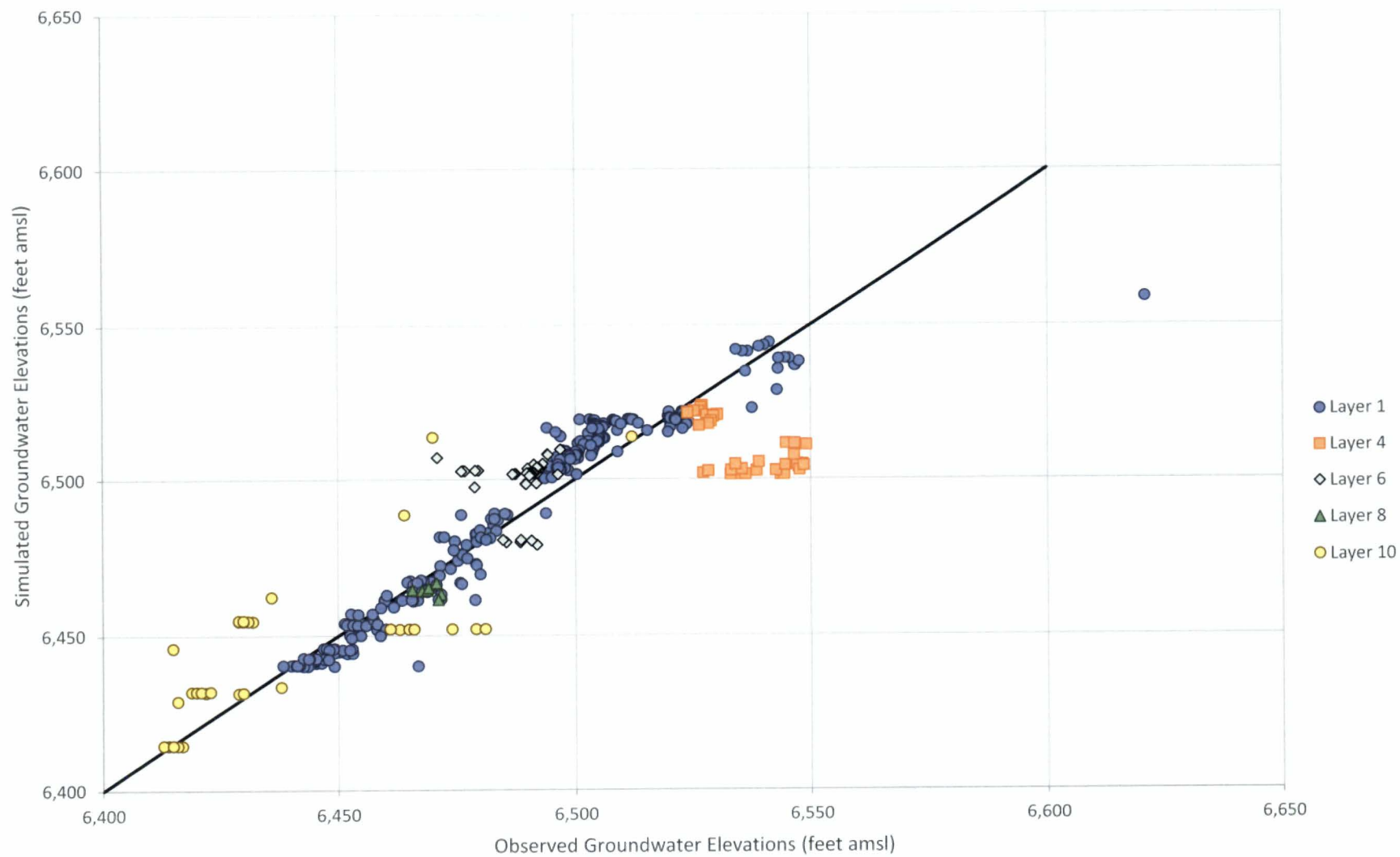
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Transport Modeling
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Project: 152816

0 2.5 5
Miles



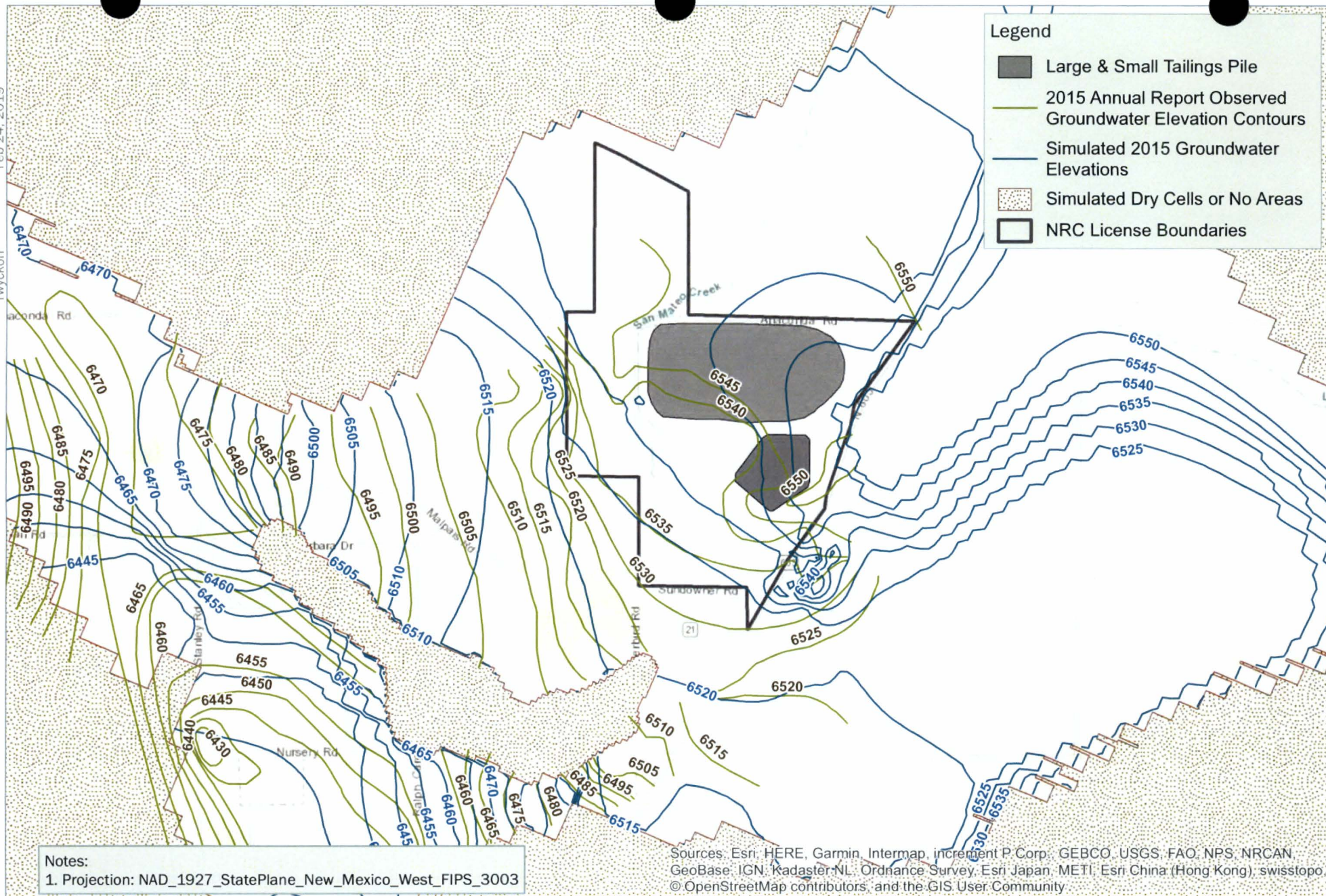
Figure 4-5

Layer 10 (San Andres/Glorieta Aquifer)
Hydraulic Conductivity and Groundwater
Elevation Targets



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Figure 4-6
Scatterplot of Simulated versus Observed
Groundwater Elevations

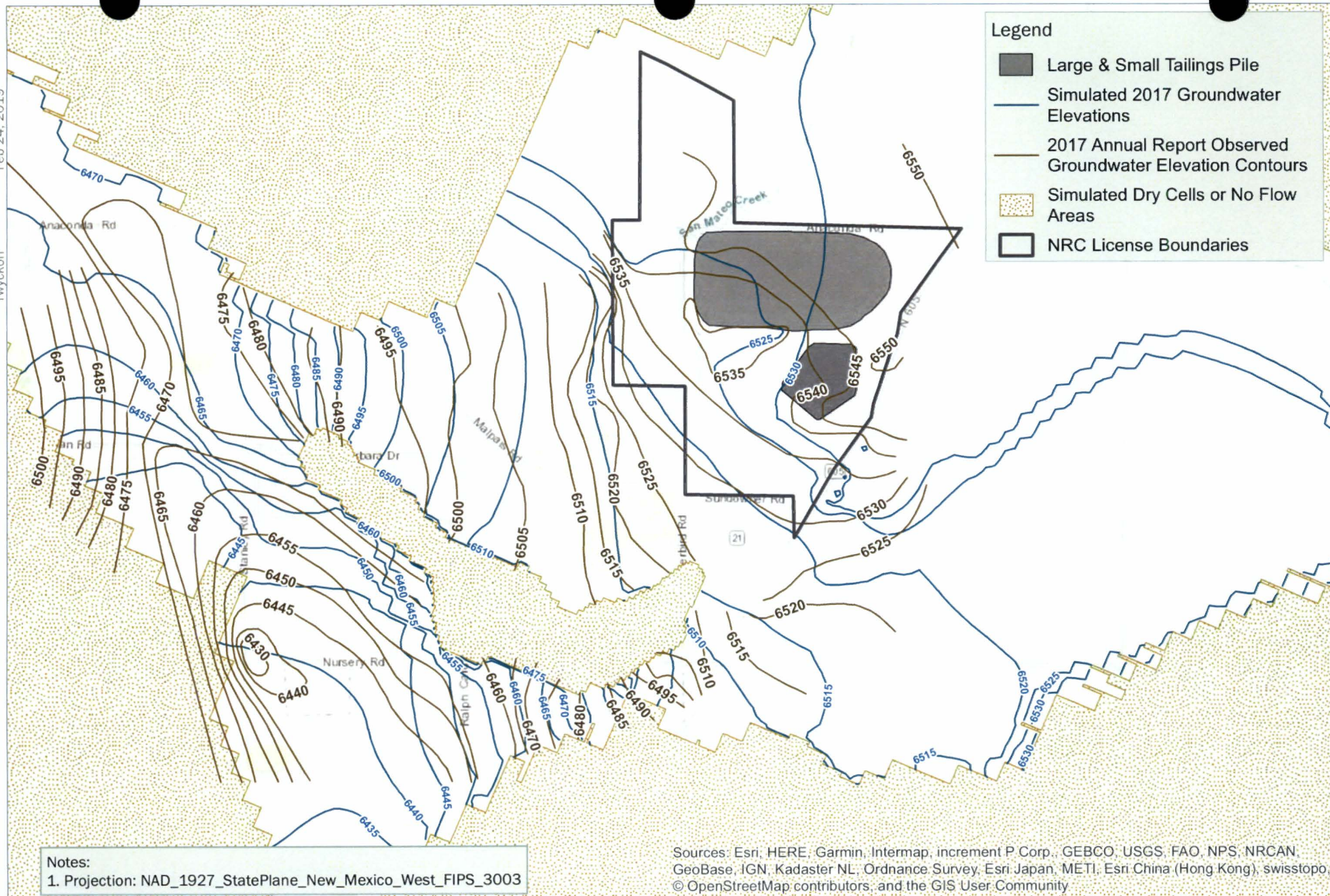


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Transport Modeling
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0 0.5 1 Miles



Figure 4-7
Alluvial Simulated vs. Observed 2015
Groundwater Elevation Contours

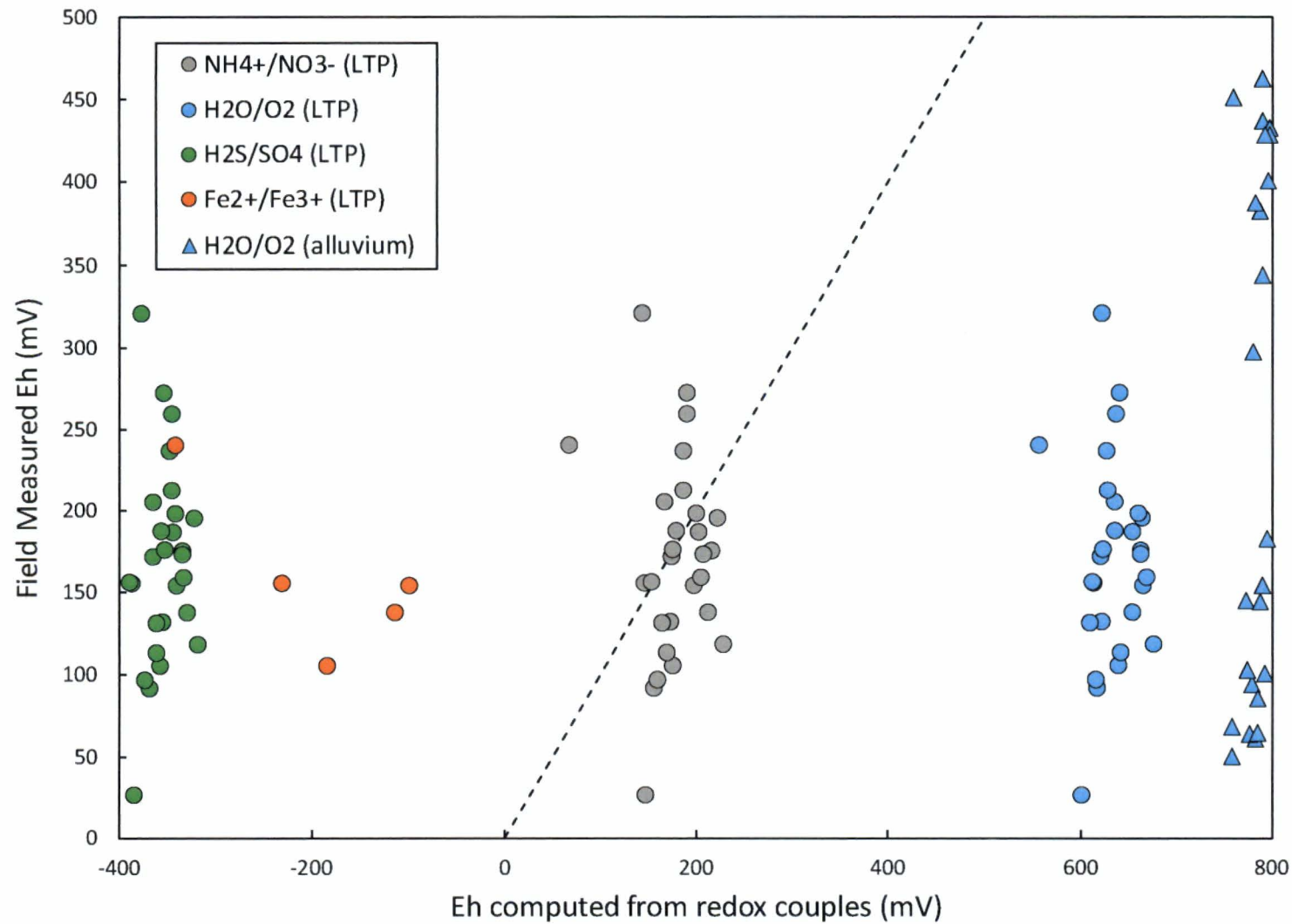


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Transport Modeling
Date: March 2019
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0 0.5 1 Miles



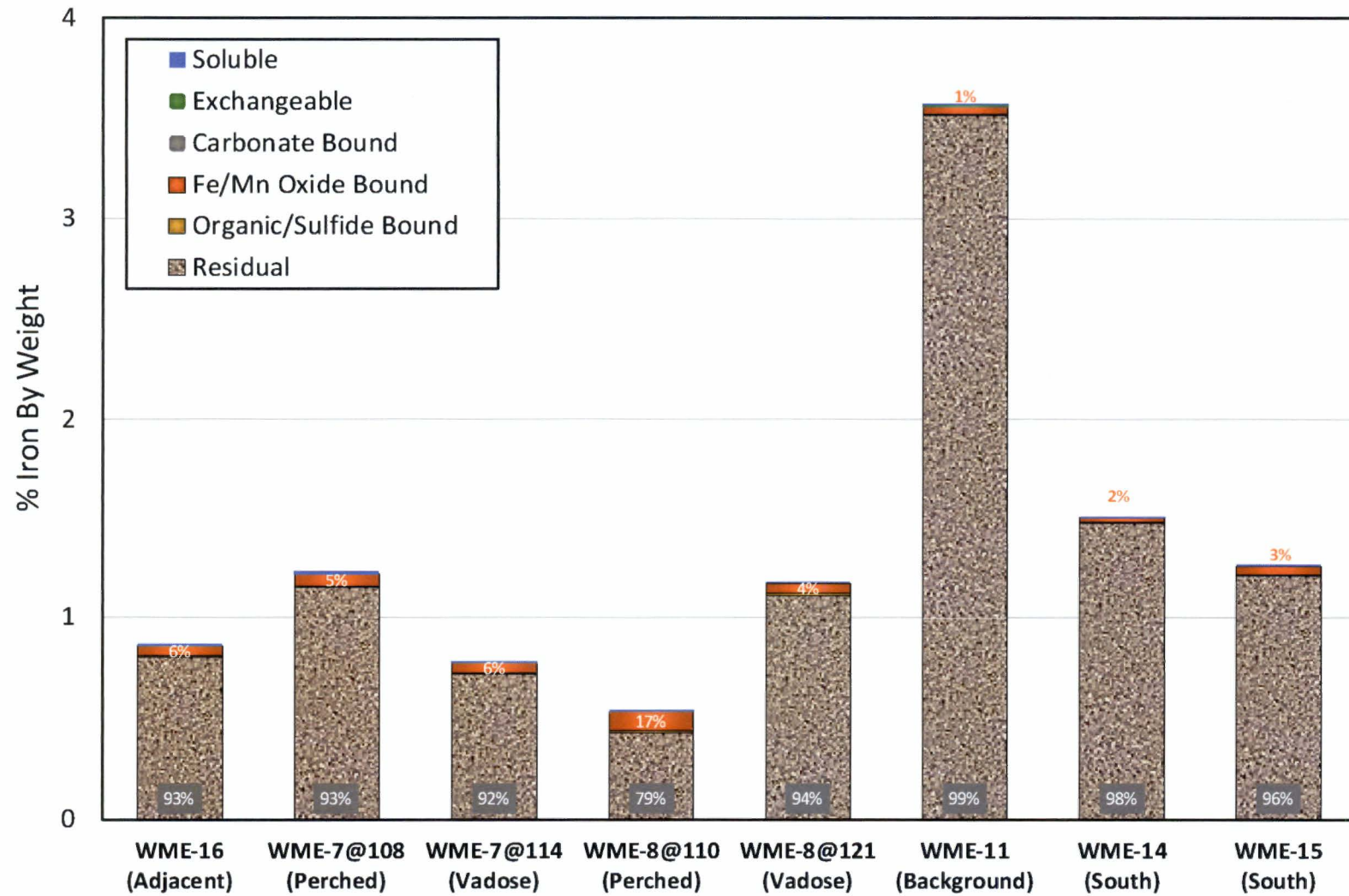
Figure 4-8
Alluvial Simulated vs. Observed 2017
Groundwater Elevation Contours



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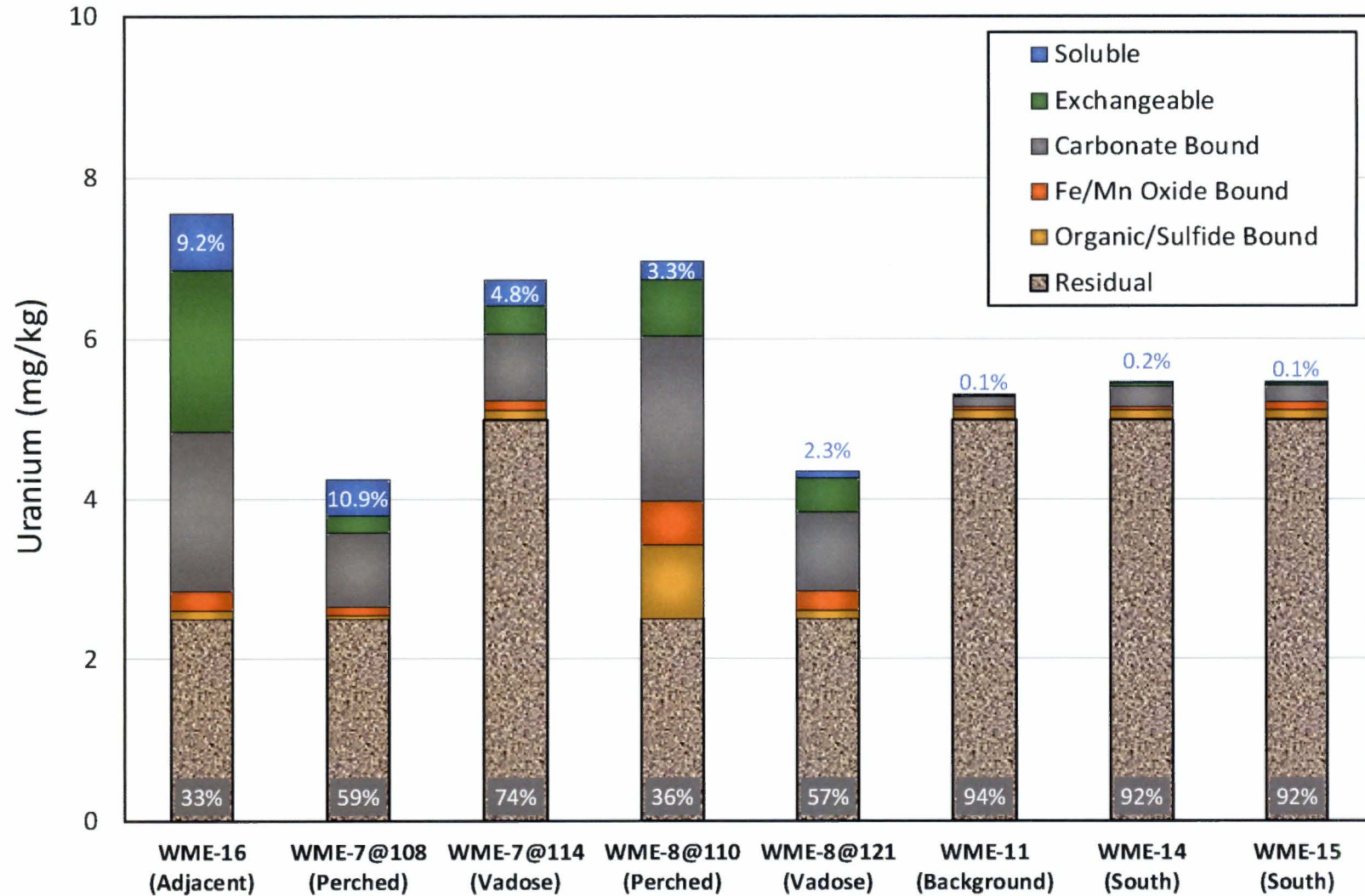
Figure 5-1

Comparison of Field-Measured Groundwater Eh and Potentials Computed from Individual Redox Couples for Selected LTP and Alluvial Wells



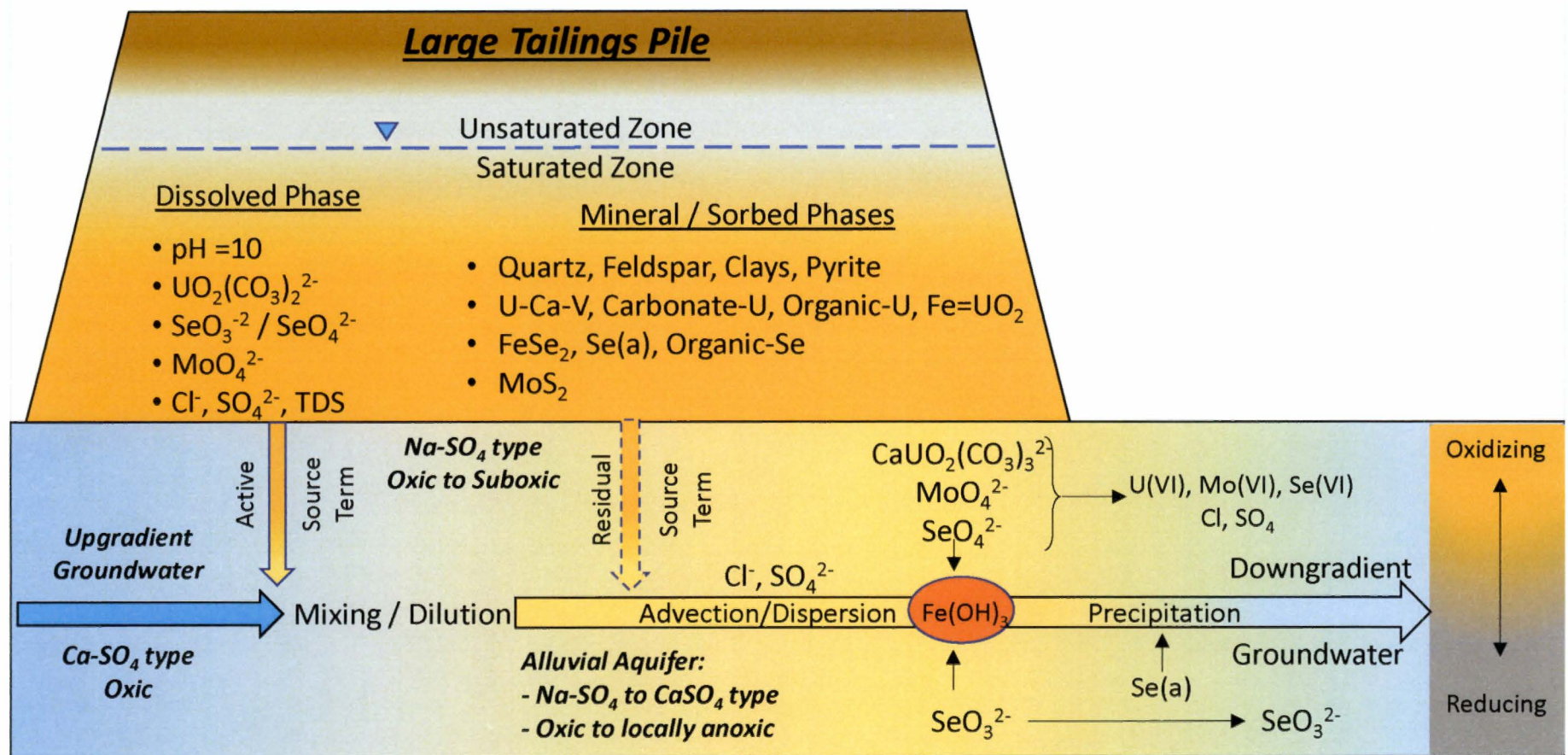
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Figure 5-2
 Selective Extraction Iron Results for Alluvium Samples



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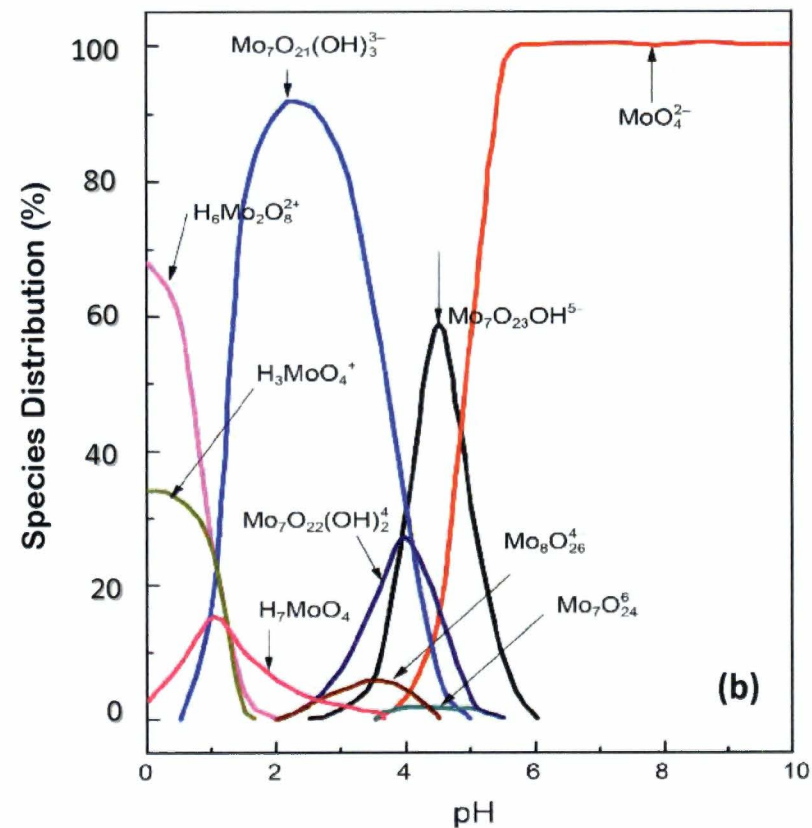
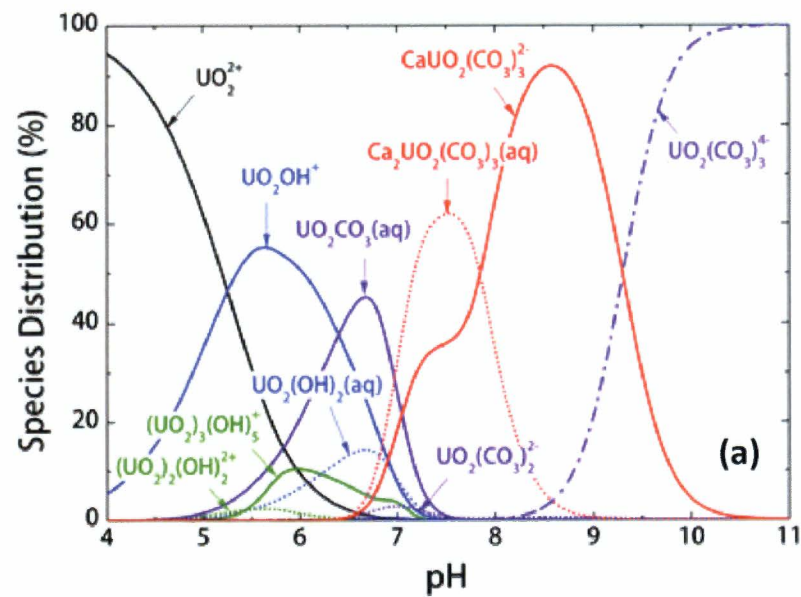
Figure 5-3
 Selective Extraction Uranium Results for
 Alluvium Samples



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Figure 5-4

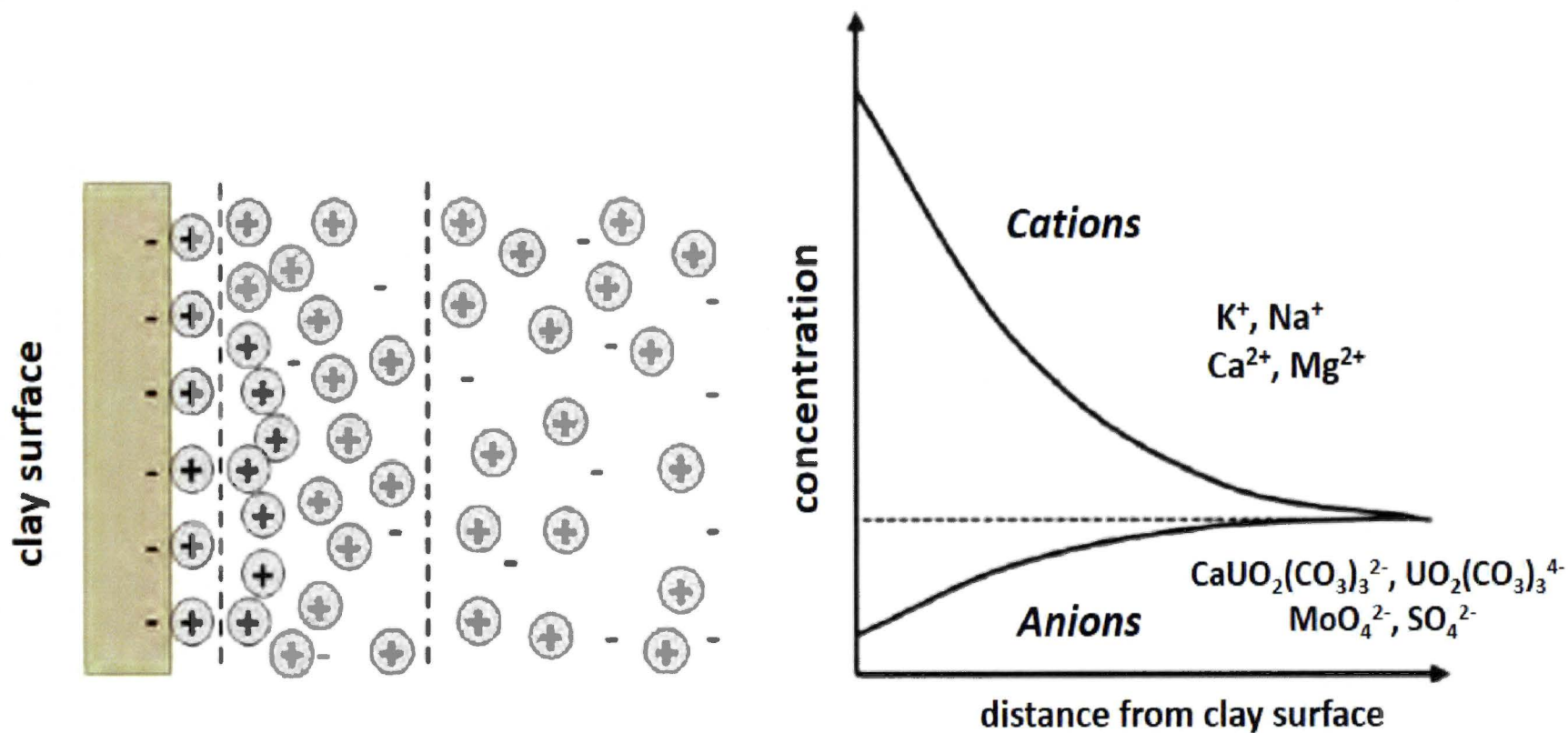
Conceptual Geochemical Model for COC Sources and Transport



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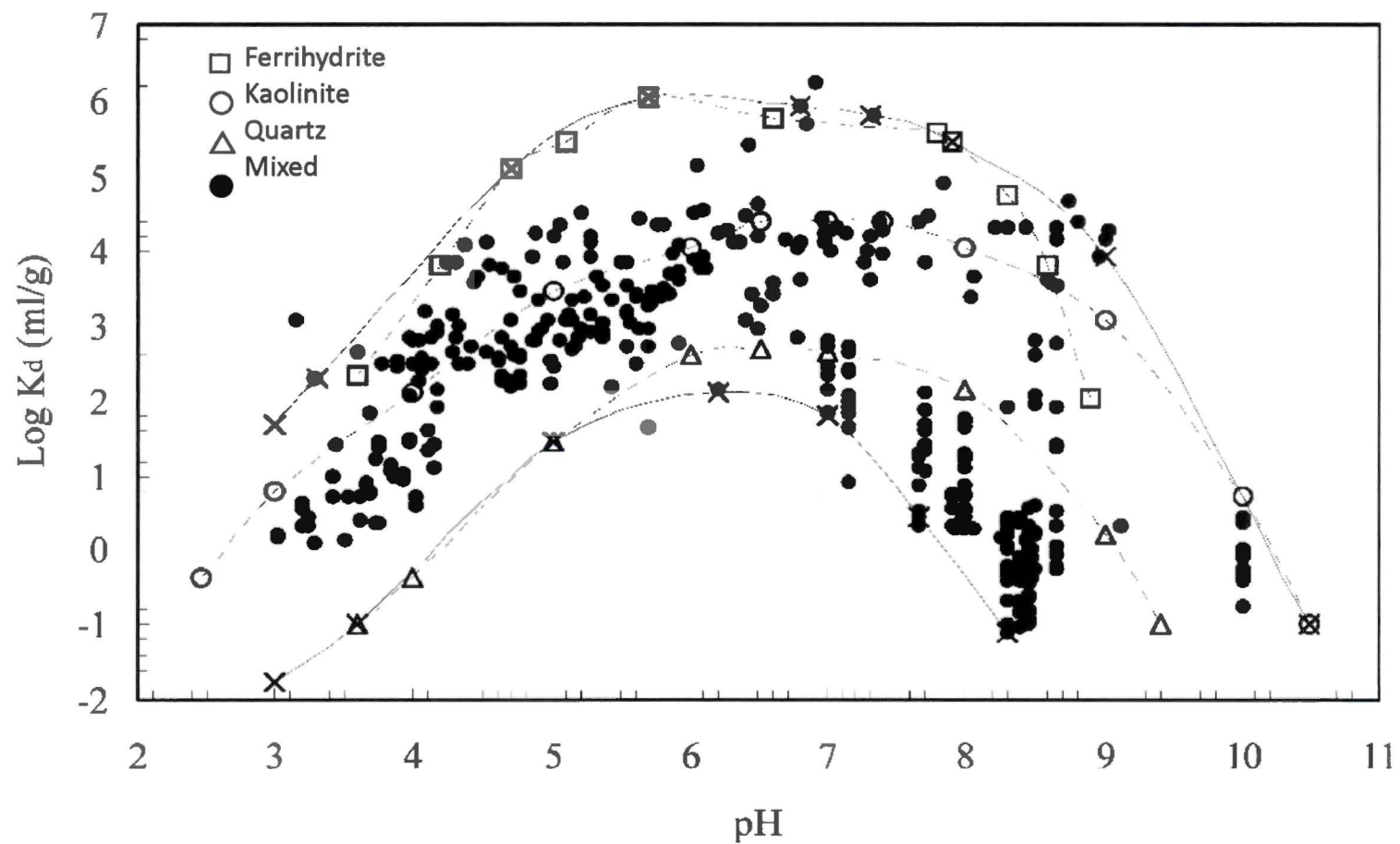
Figure 5-5

(a) Uranium and (b) molybdenum speciation as a function of pH (Lee and Yun, 2013; Lee et al., 2011)



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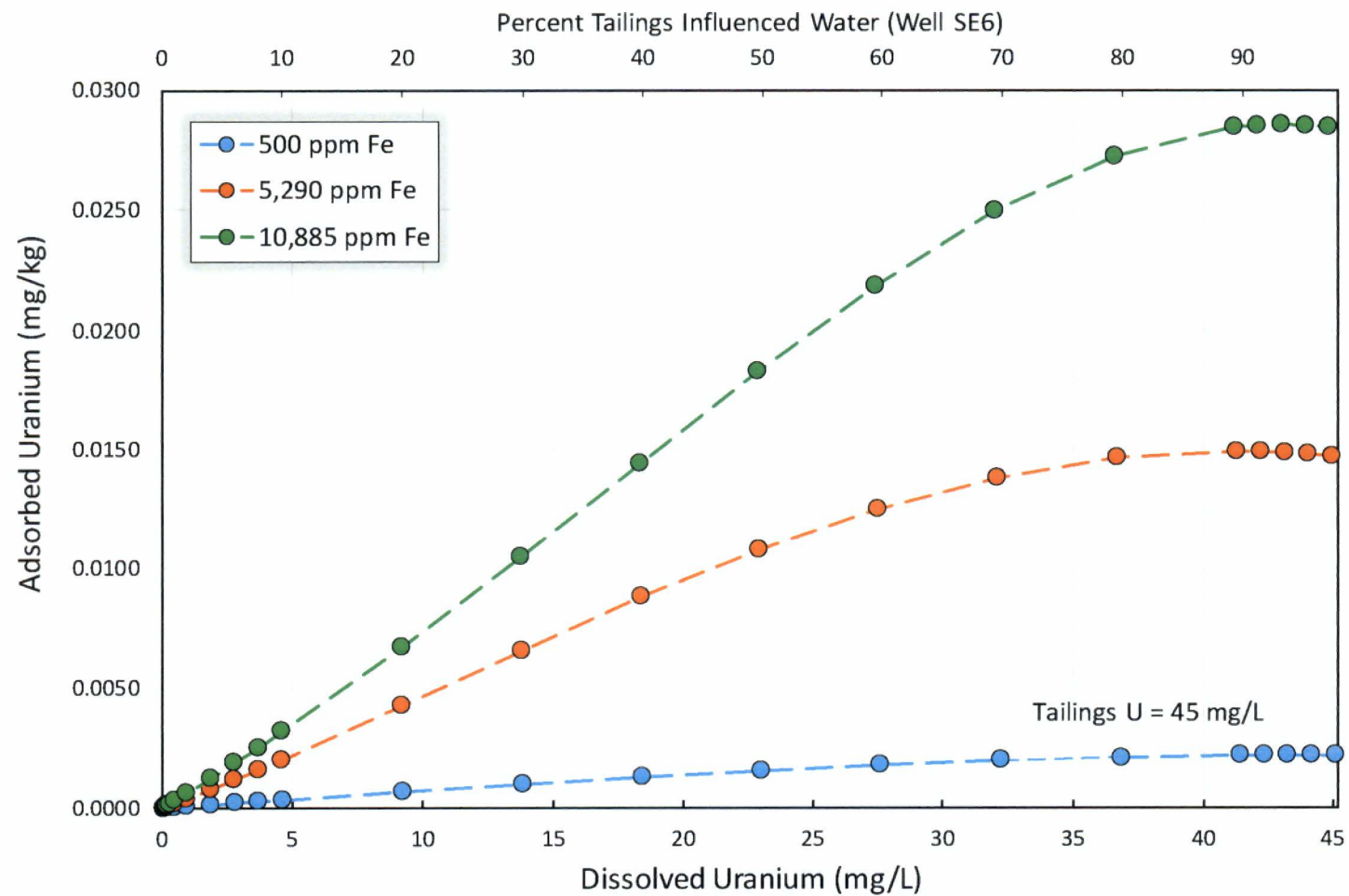
Figure 5-6
 Distribution of Ions Adjacent to a Clay Surface



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Figure 5-7

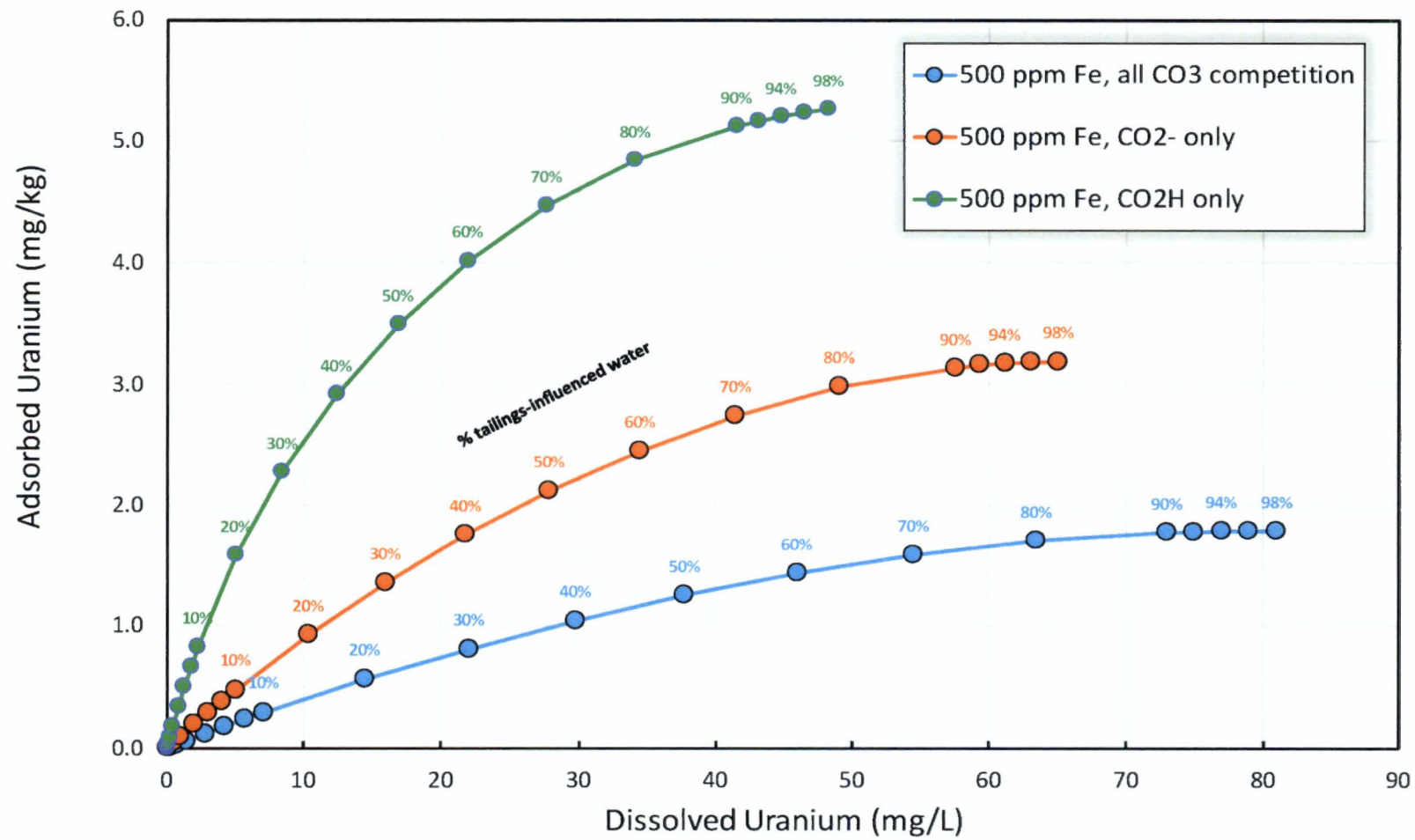
Range of Uranium K_d Values Compiled by the
 USEPA (1999) for Various Minerals



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Figure 5-8

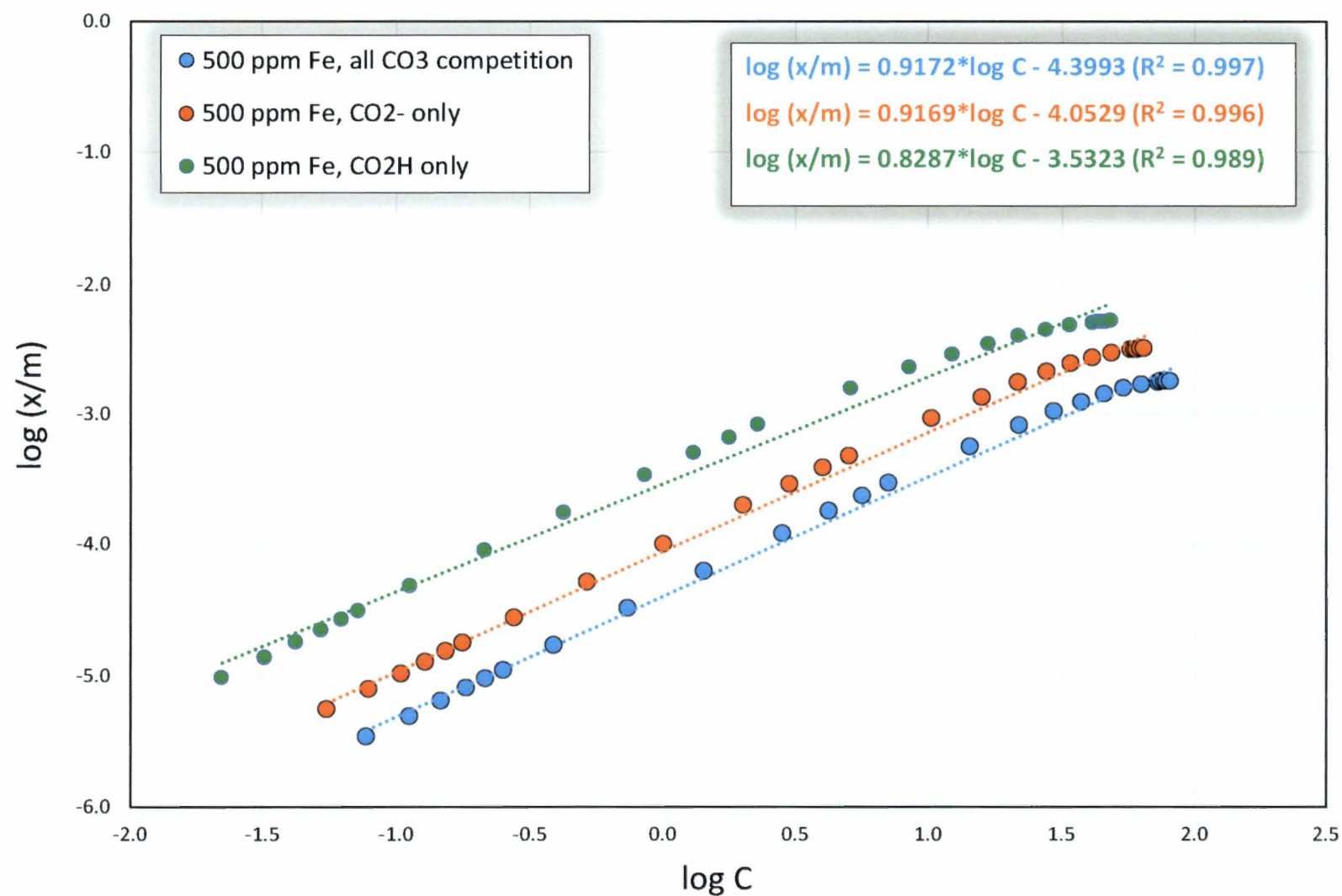
Initial Modeling Results Simulating UO_2^{2+}
Adsorption Onto Ferrihydrite for Three
Different Iron Concentrations



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Figure 5-9

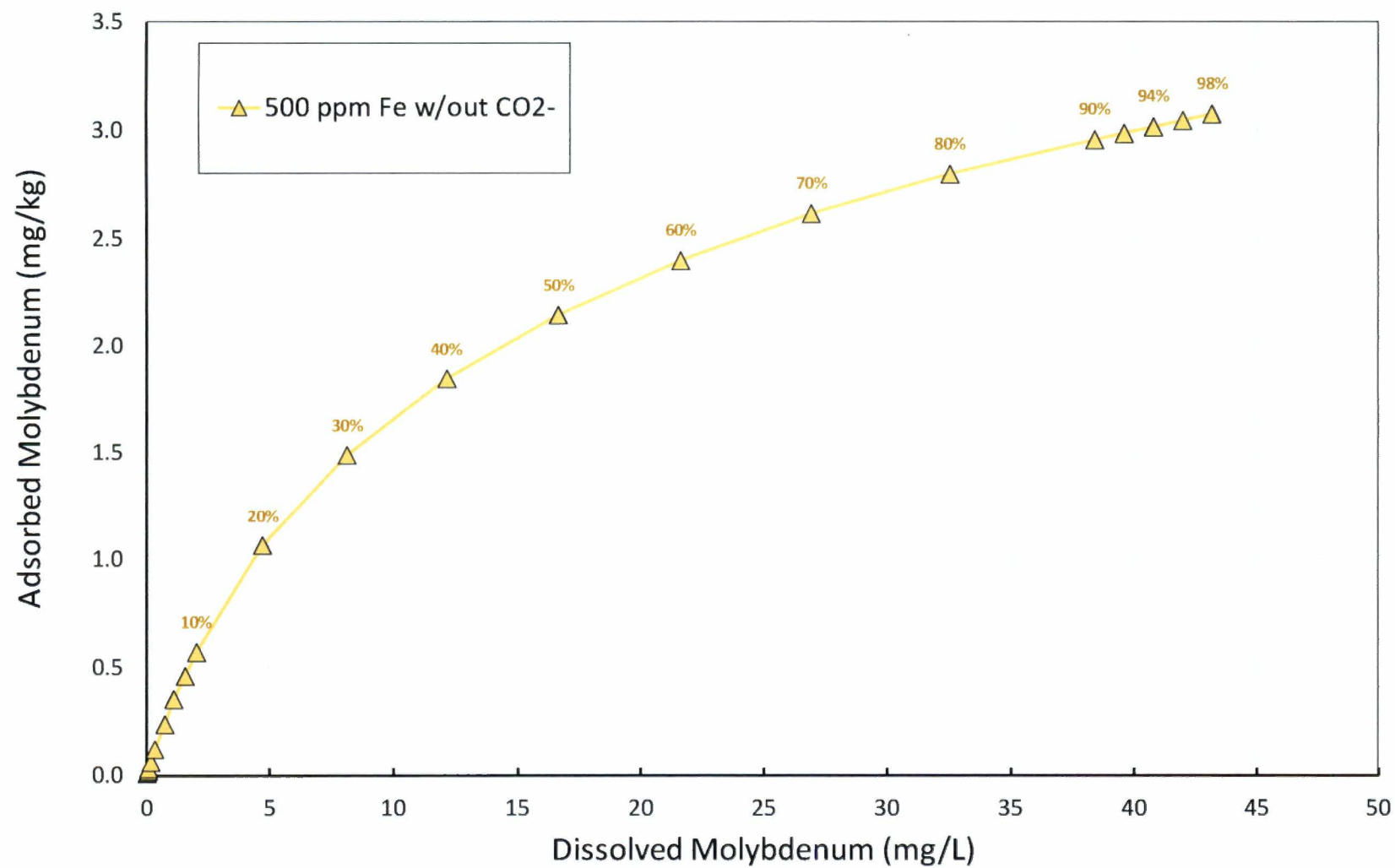
Model Results Showing the Effect of Adsorbed Carbonate Species on Uranium Adsorption With Increasing Percentage of Tailings-Influenced Water



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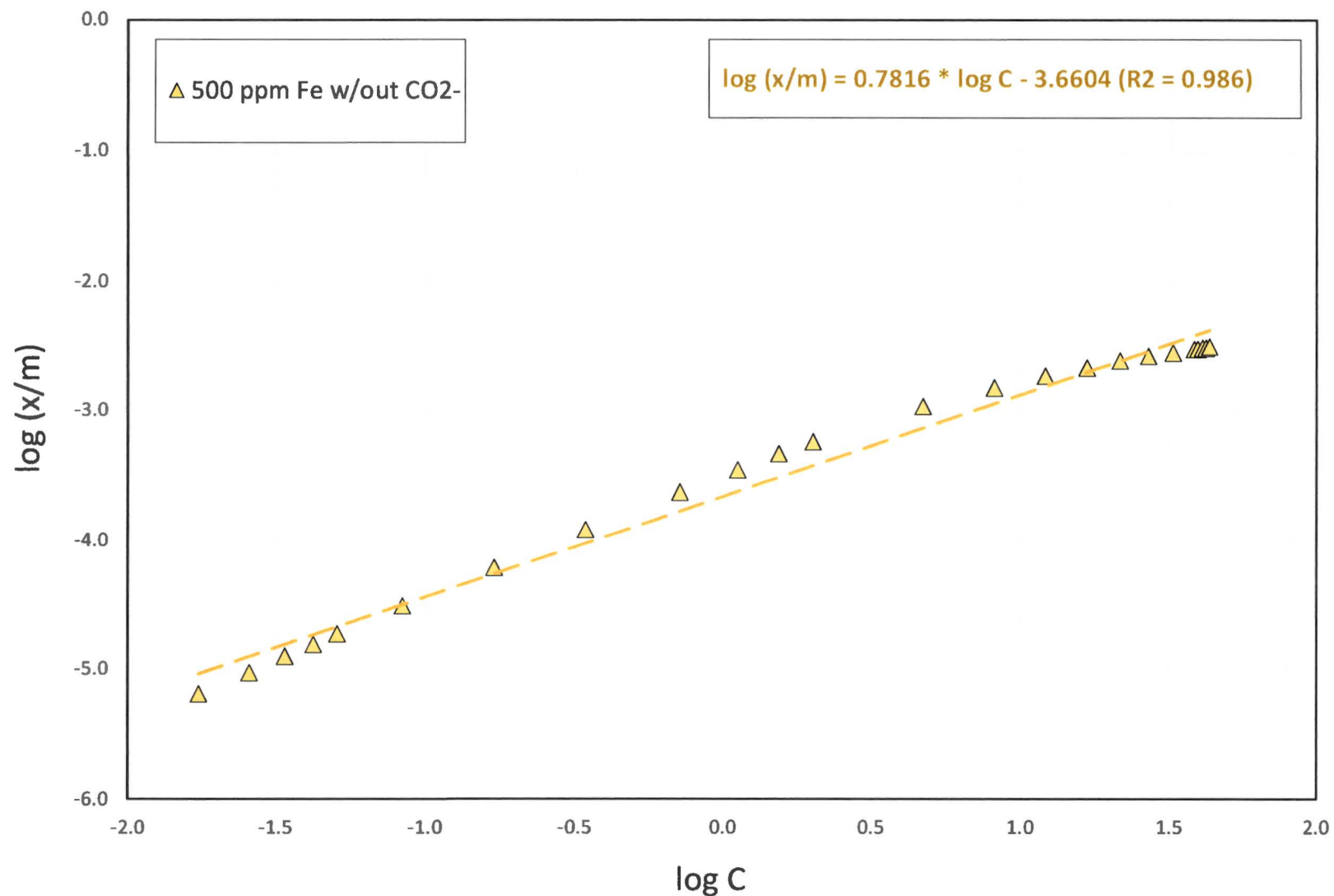
Figure 5-10

**Linear Freundlich Isotherm Plot for Adsorption
 of Various Carbonate Species**



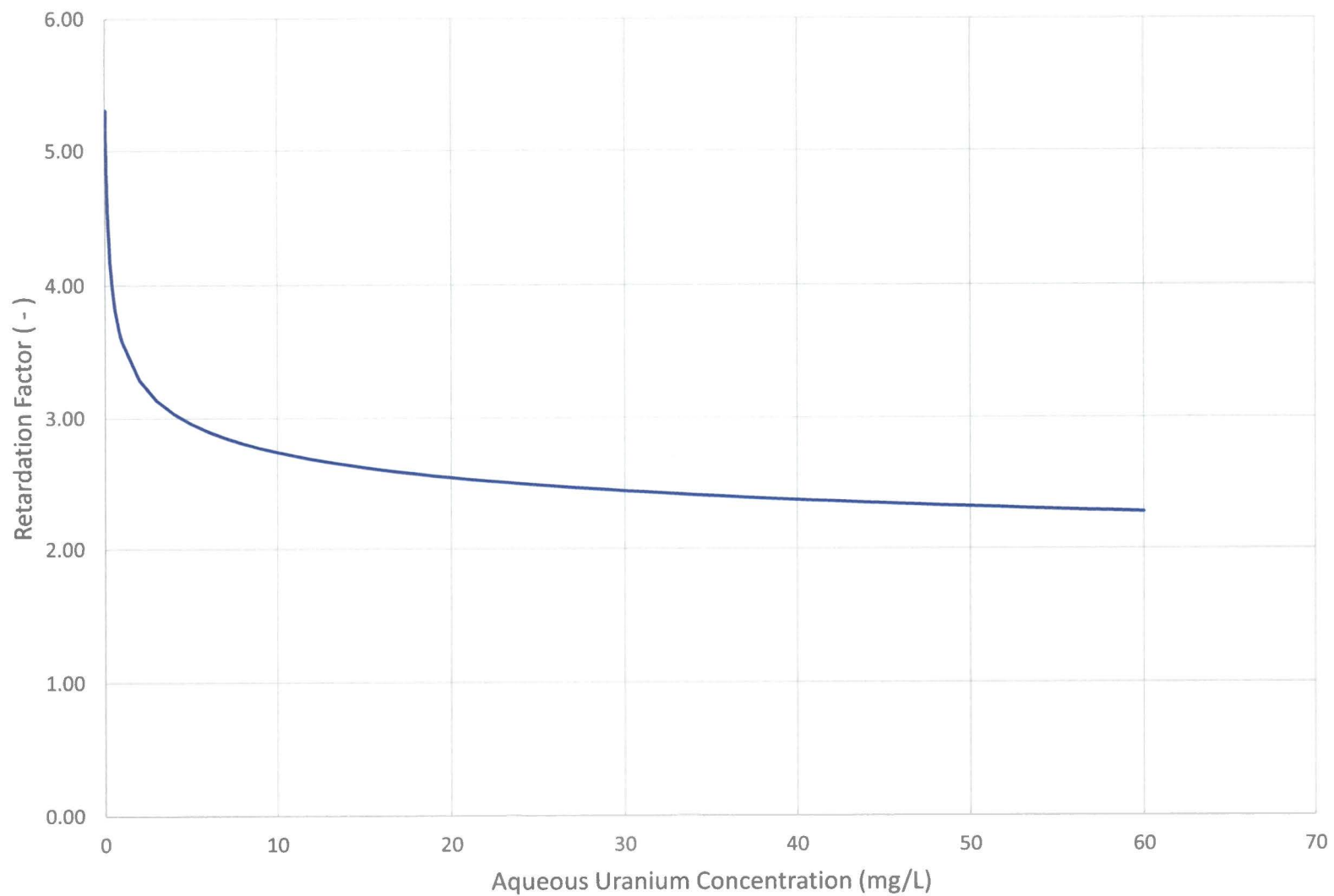
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Figure 5-11
Model Adsorption Curve for Molybdenum



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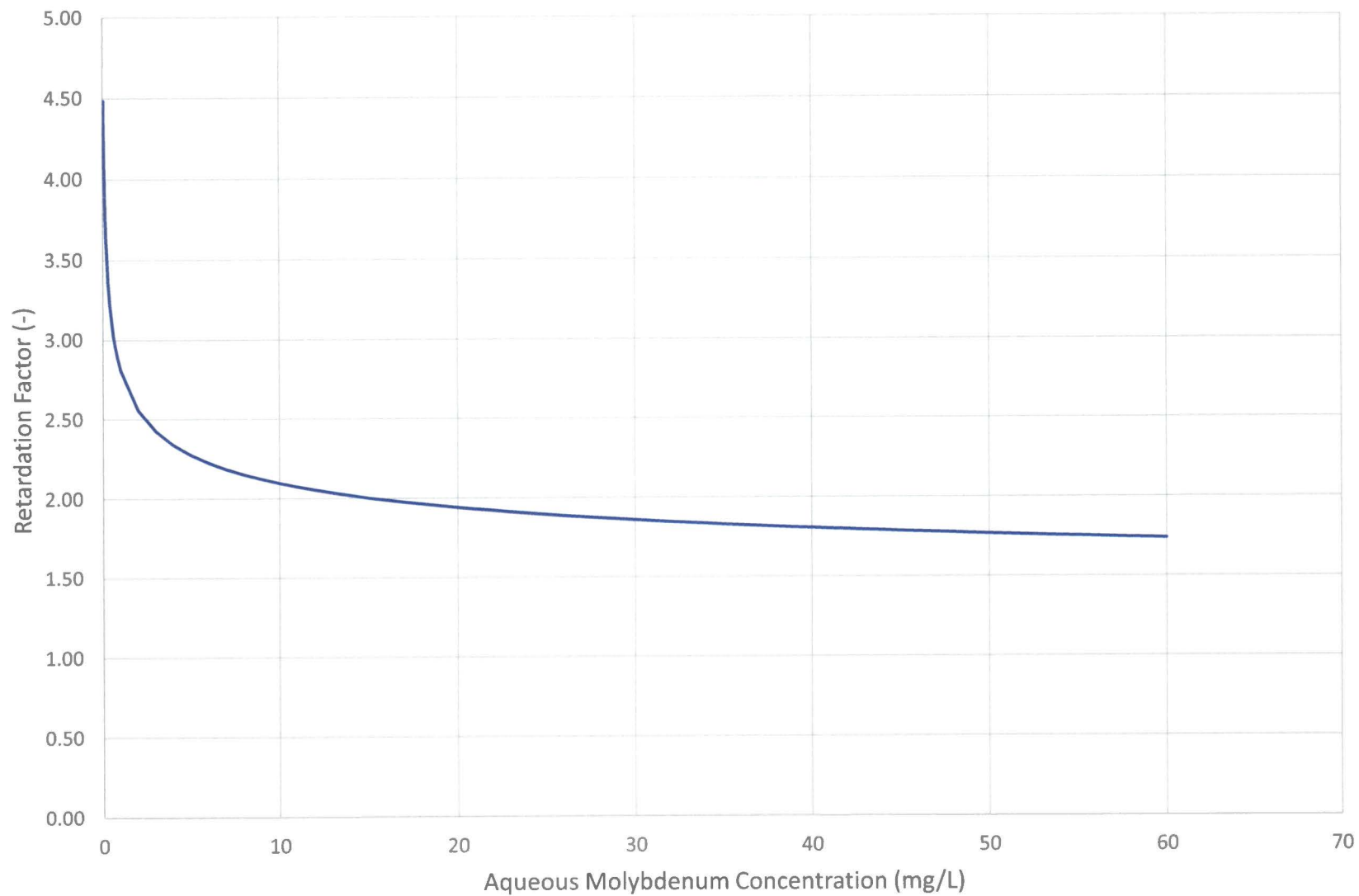
Figure 5-12
Linear Freundlich Isotherm Plot for Molybdenum



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Figure 5-13

**Retardation and Aqueous Uranium Concentration
Relationship for Transport Modeling**



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Figure 5-14
Retardation and Aqueous Molybdenum
Concentration Relationship for Transport Modeling

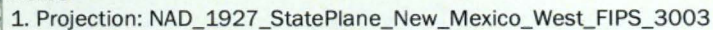
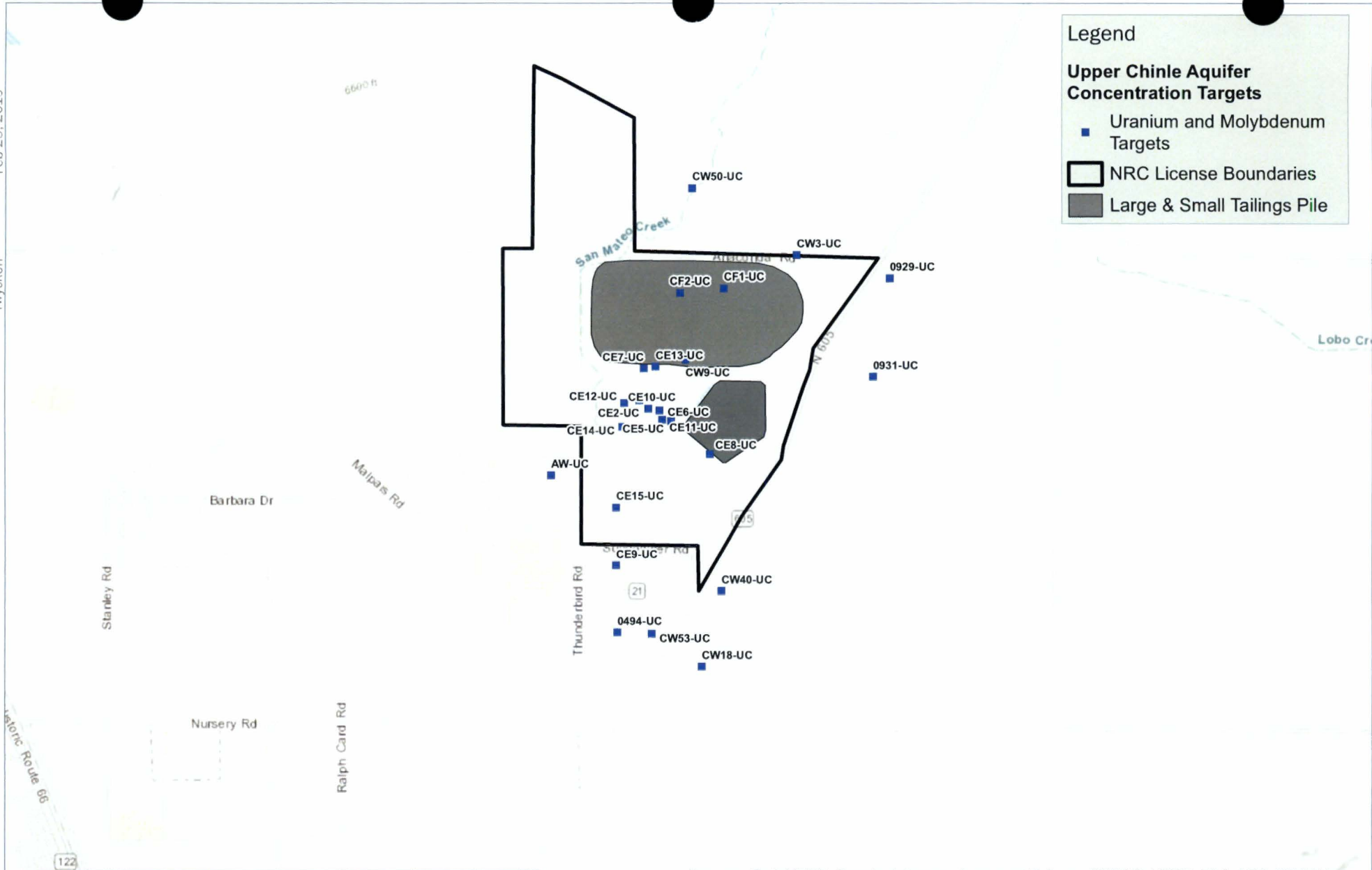


Figure 5-15

Layer 1 (Alluvial Aquifer) Uranium and Molybdenum Concentration Targets

\\BCDENFP01\Projects\Data\GEN\Barrick Homestake\Grants Groundwater Model\GIS_SiteModelReporting\Figure5_x2_Ly04_HydraulicAndConcTargs.mxd
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Legend

**Upper Chinle Aquifer
Concentration Targets**

- Uranium and Molybdenum Targets
- NRC License Boundaries
- Large & Small Tailings Pile

Notes:
1. Projection: NAD_1927_StatePlane_New_Mexico_West_FIPS_3003

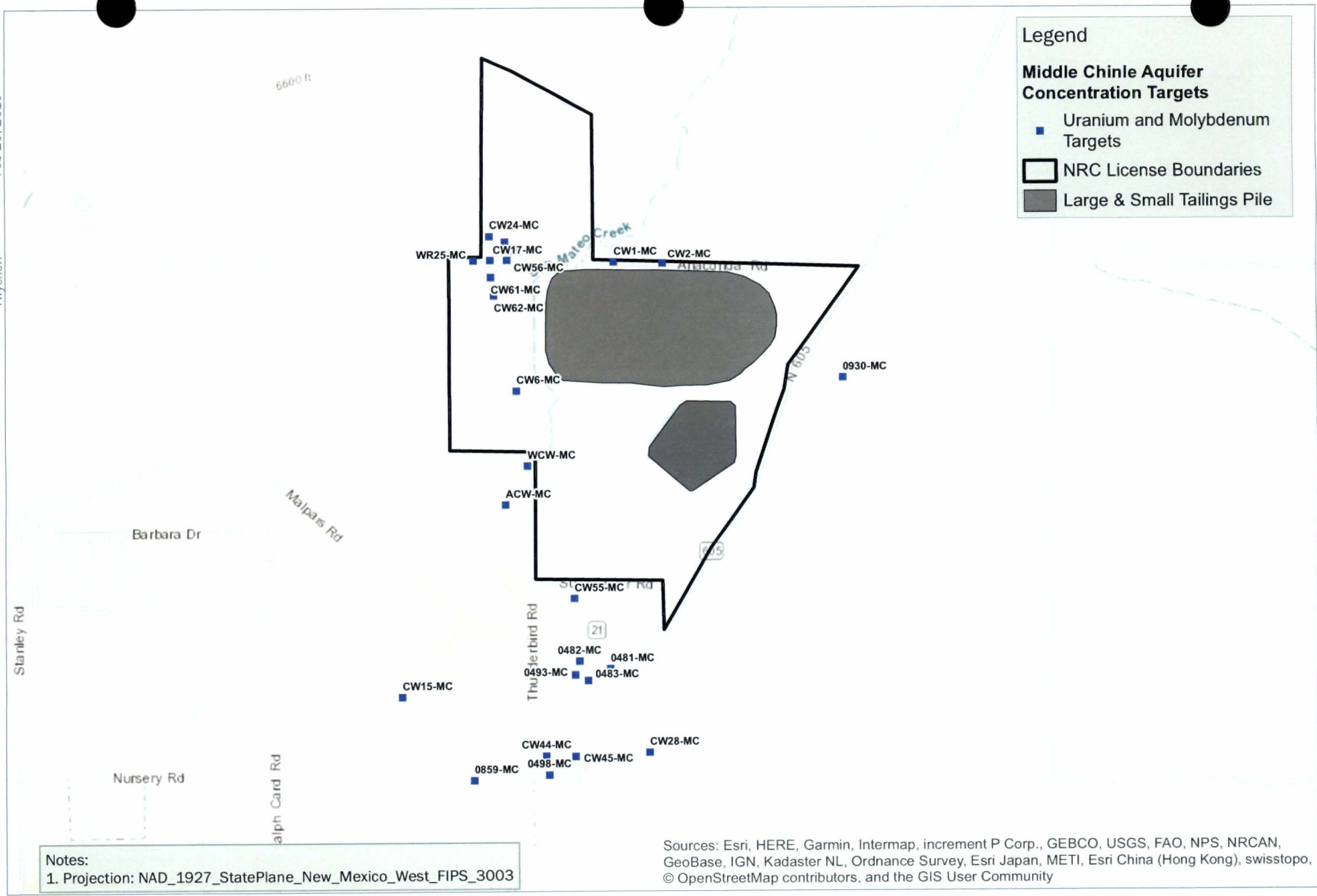
Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, © OpenStreetMap contributors, and the GIS User Community.



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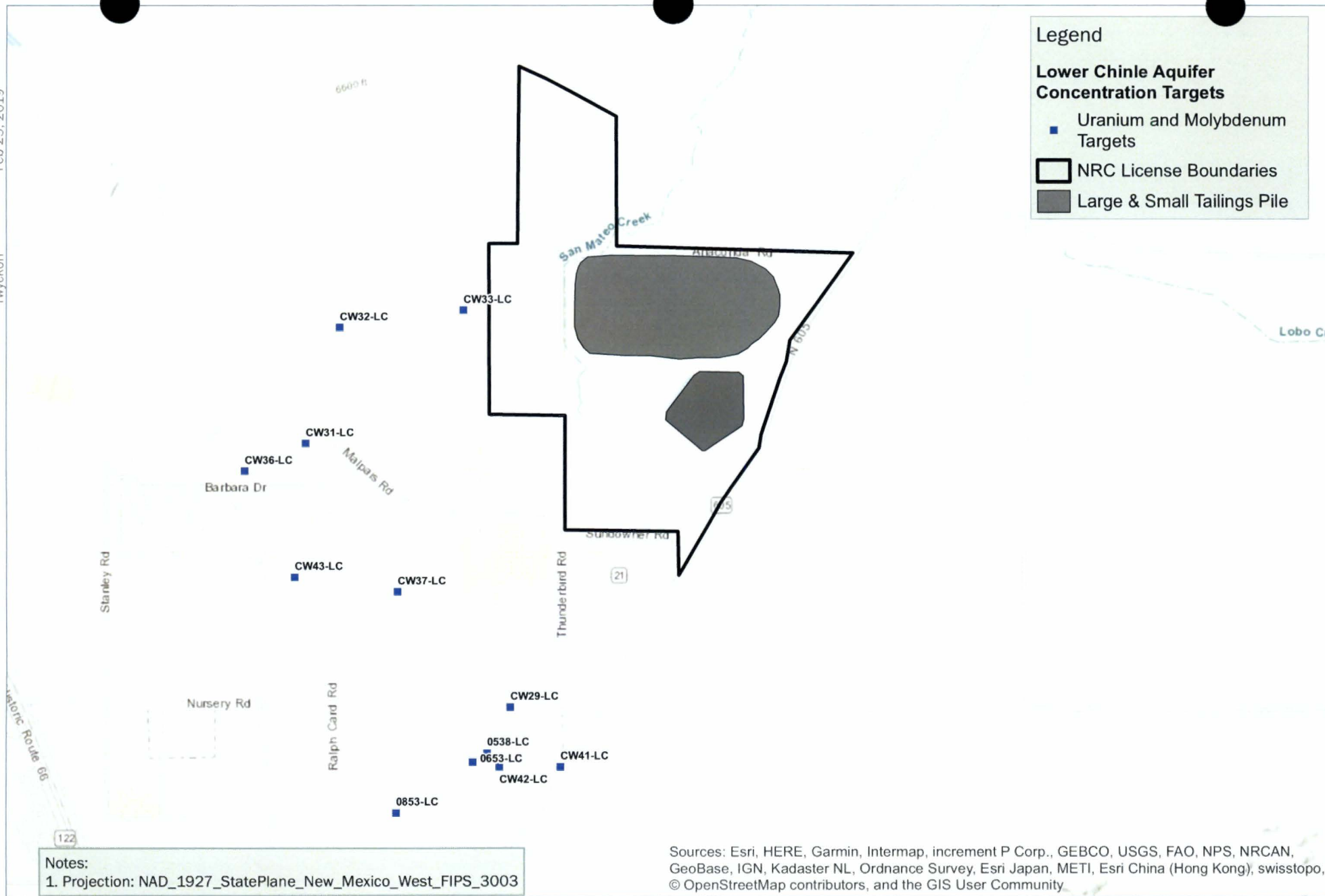
Figure 5-16
Layer 4 (Upper Chinle Aquifer)
Uranium and Molybdenum
Concentration Targets



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Figure 5-17
Layer 6 (Middle Chinle Aquifer)
Uranium and Molybdenum Concentration Targets



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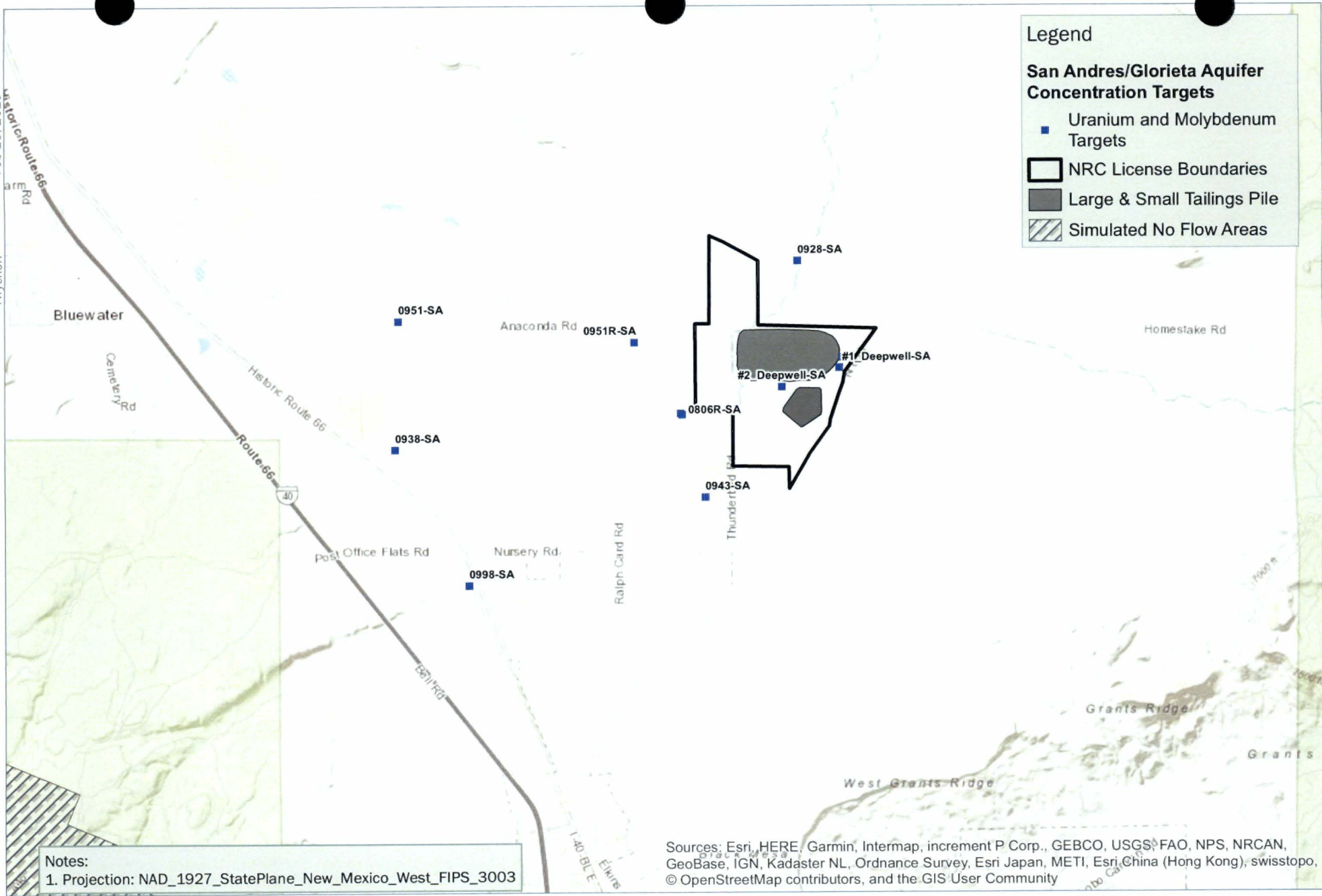
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Feet



Figure 5-18

Layer 8 (Lower Chinle Aquifer)
Uranium and Molybdenum
Concentration Targets

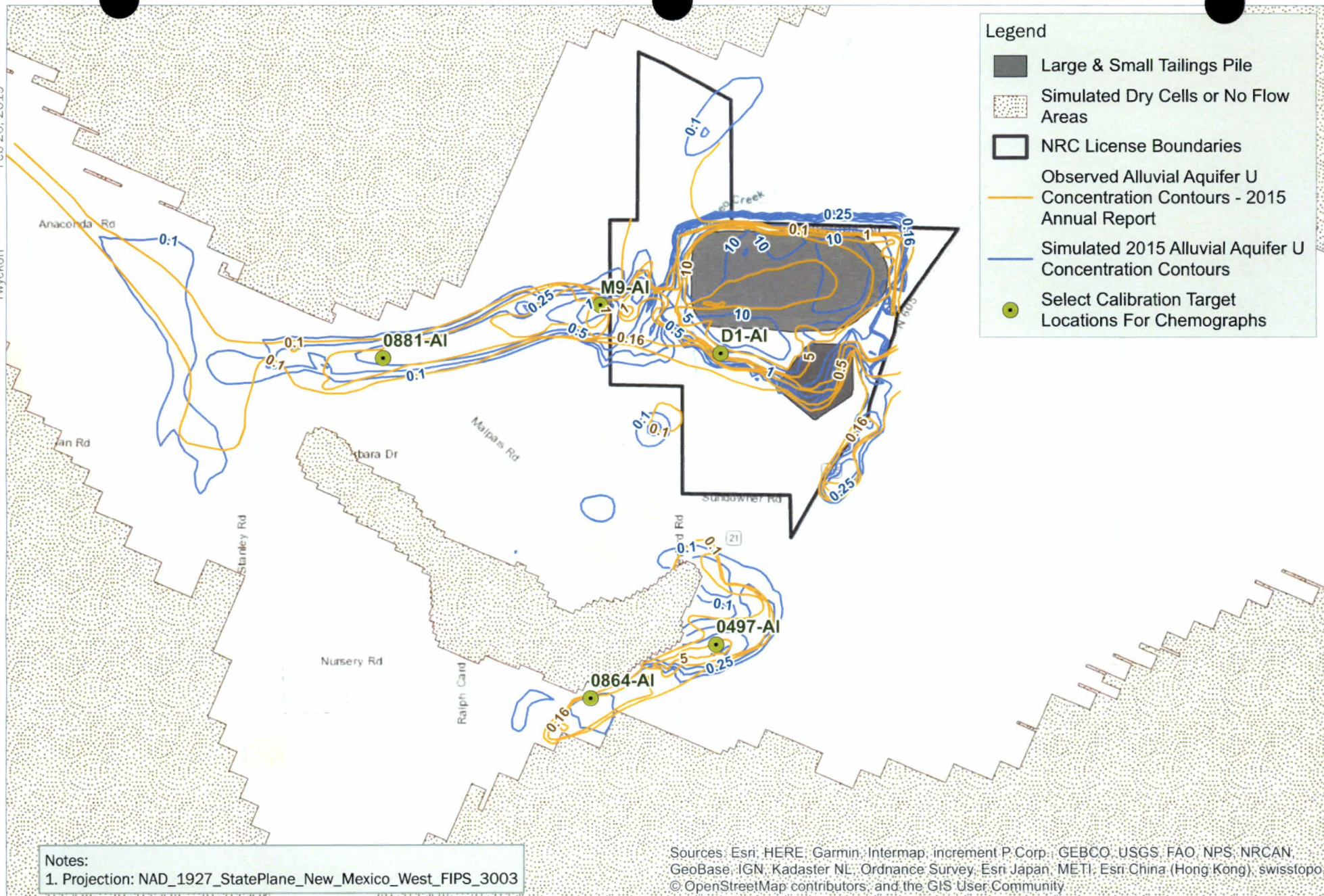
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Figure 5-19
Layer 10 (San Andres/Glorieta Aquifer)
Uranium and Molybdenum
Concentration Targets

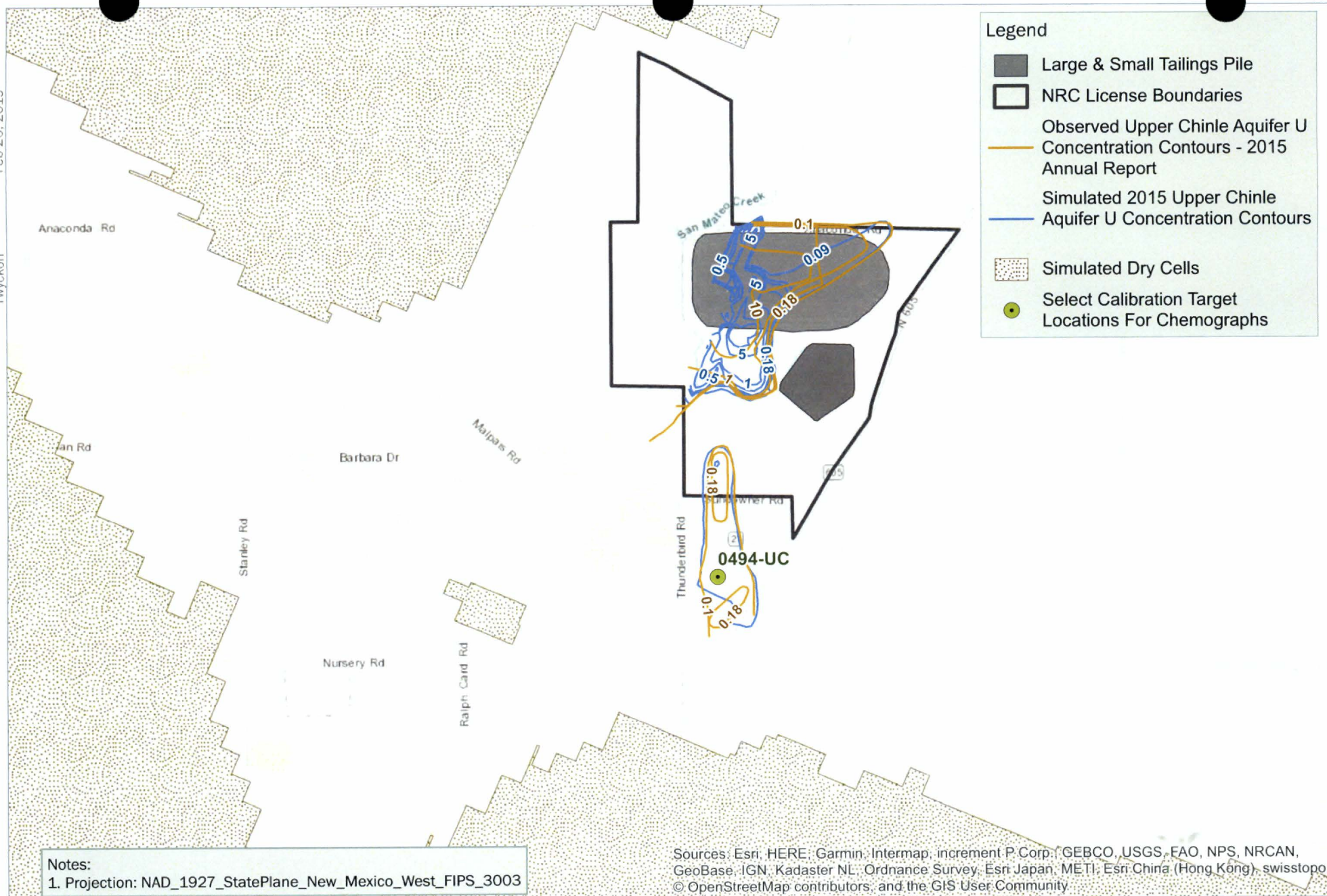


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0 0.5 1 Miles



Figure 5-20
Alluvial Aquifer Simulated vs. Observed 2015
Uranium Concentration Contours

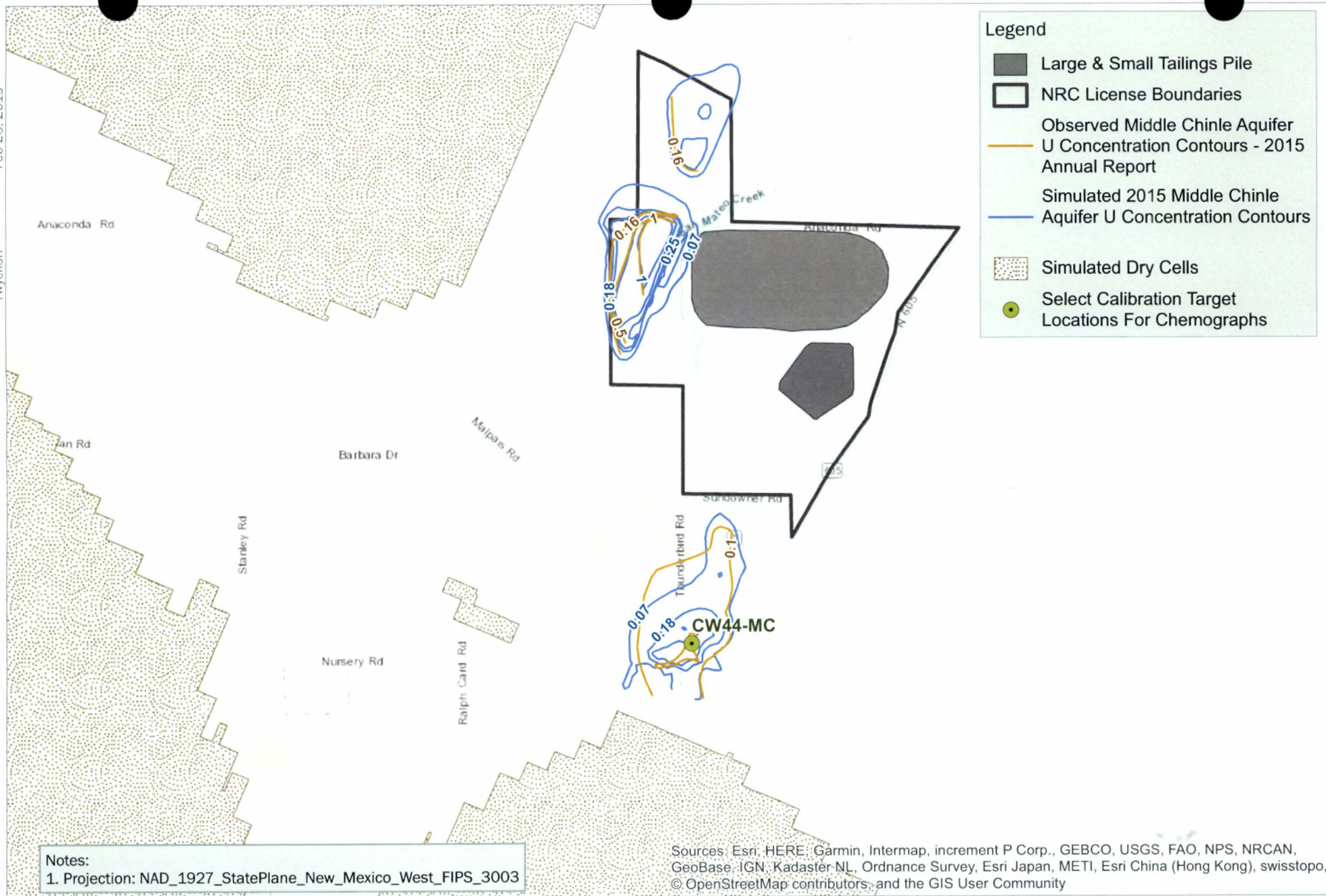


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Transport Modeling
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0 0.5 1 Miles



Figure 5-21
Upper Chinle Aquifer Simulated vs.
Observed 2015 Uranium
Concentration Contours

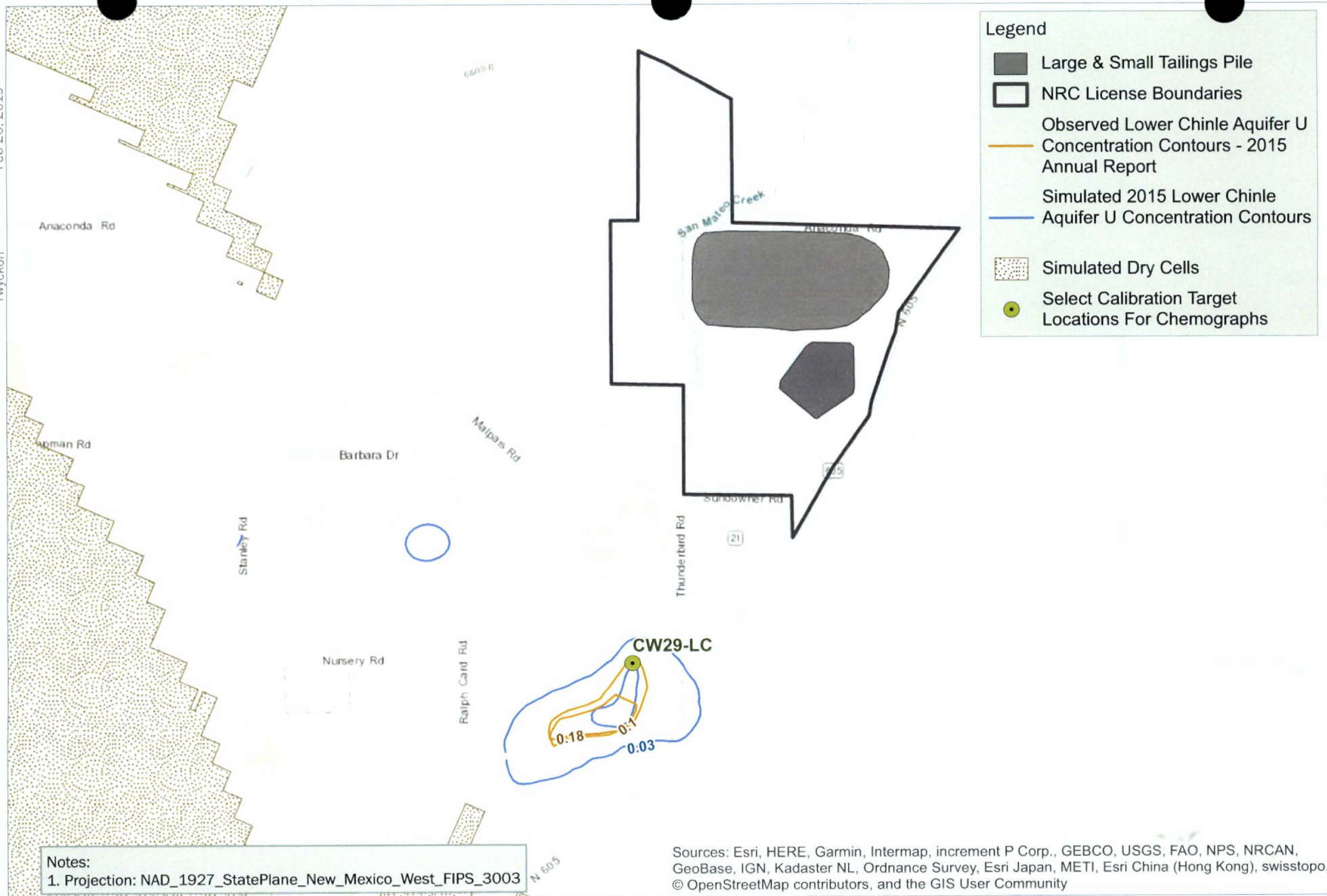


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0 0.5 1 Miles



Figure 5-22
Middle Chinle Aquifer Simulated vs.
Observed 2015 Uranium
Concentration Contours

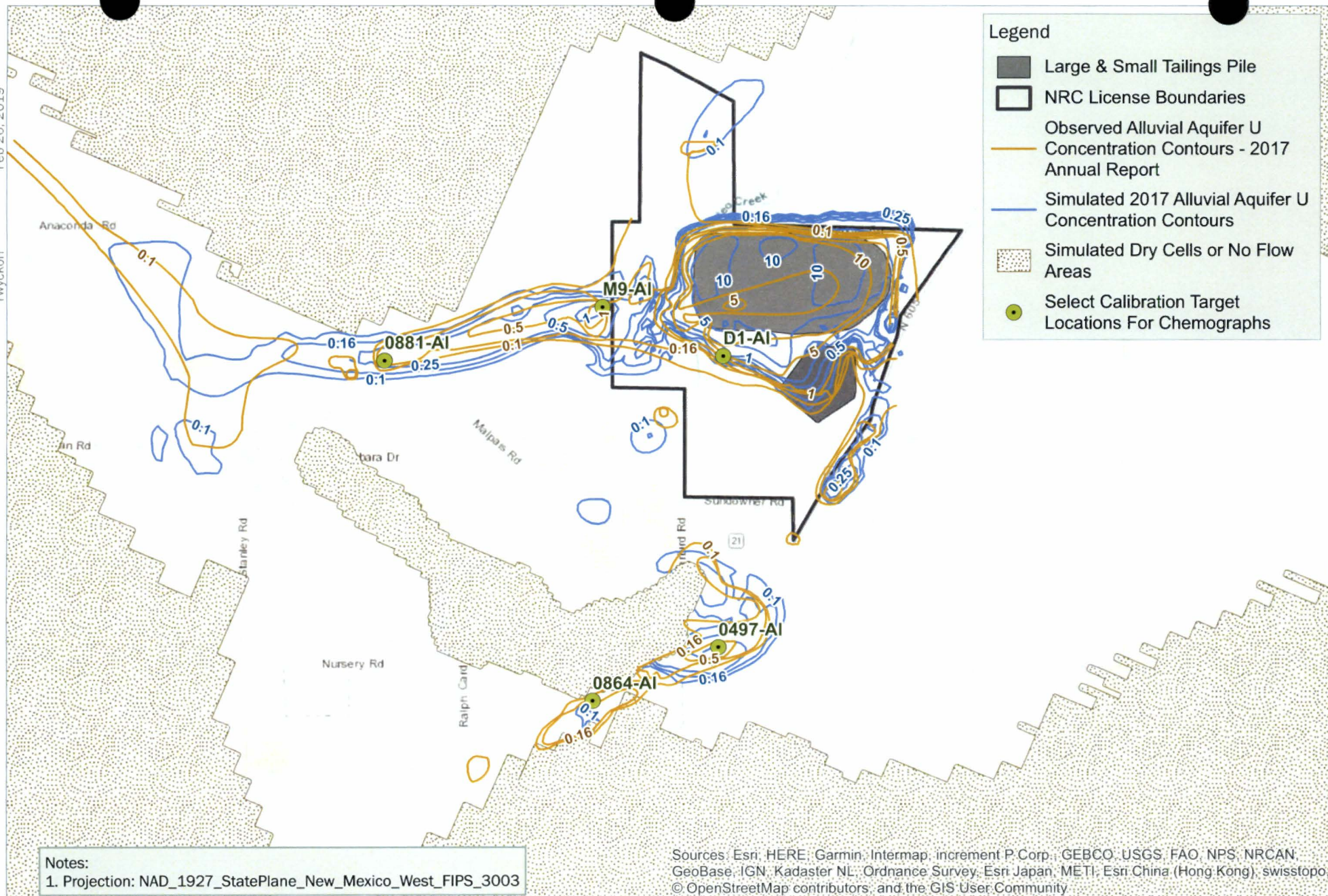


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Date: March 2019
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0 0.5 1 Miles



Figure 5-23
Lower Chinle Aquifer Simulated vs.
Observed 2015 Uranium
Concentration Contours

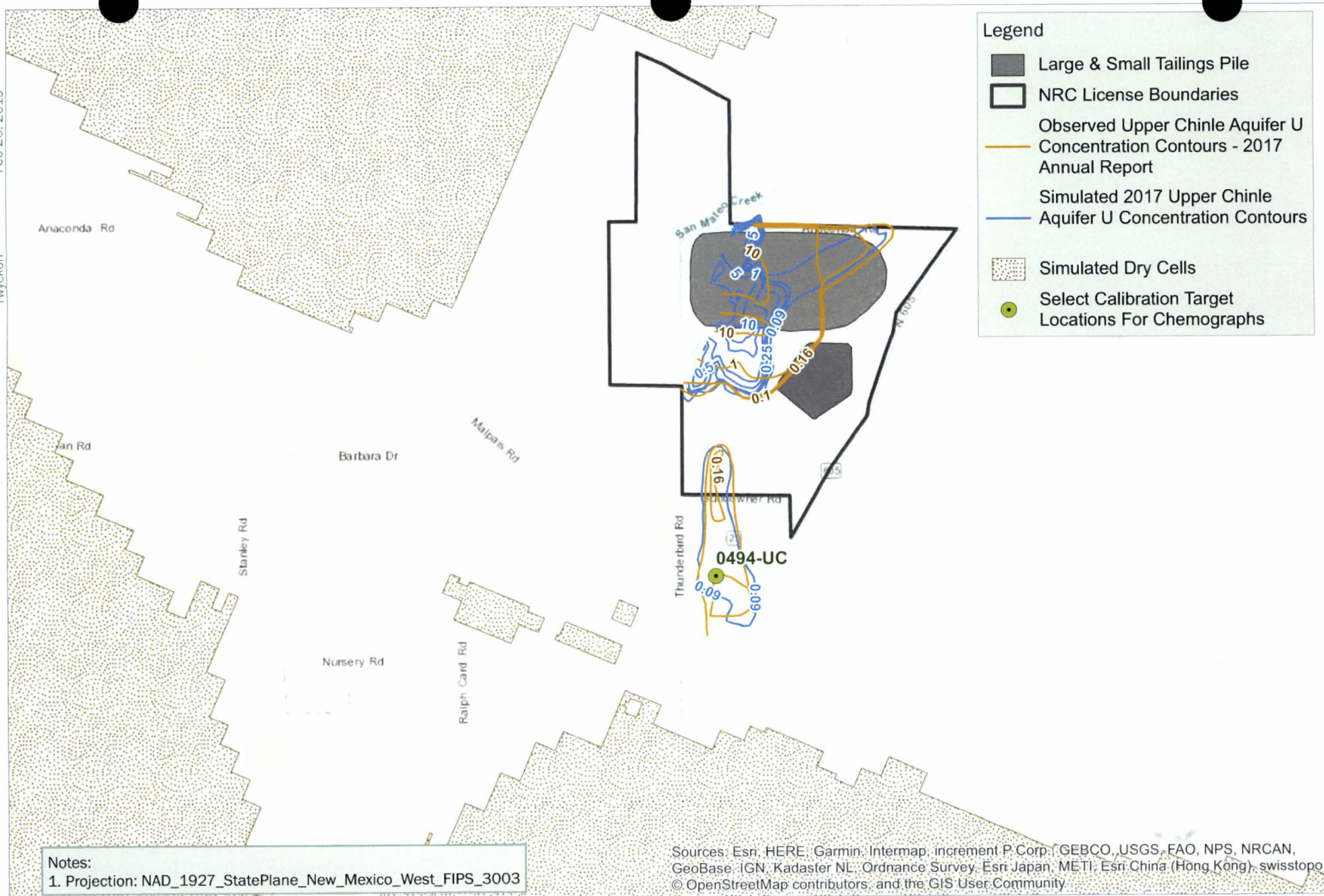


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 Date: March 2019
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0 0.5 1 Miles



Figure 5-24
Alluvial Aquifer Simulated vs. Observed 2017
Uranium Concentration Contours

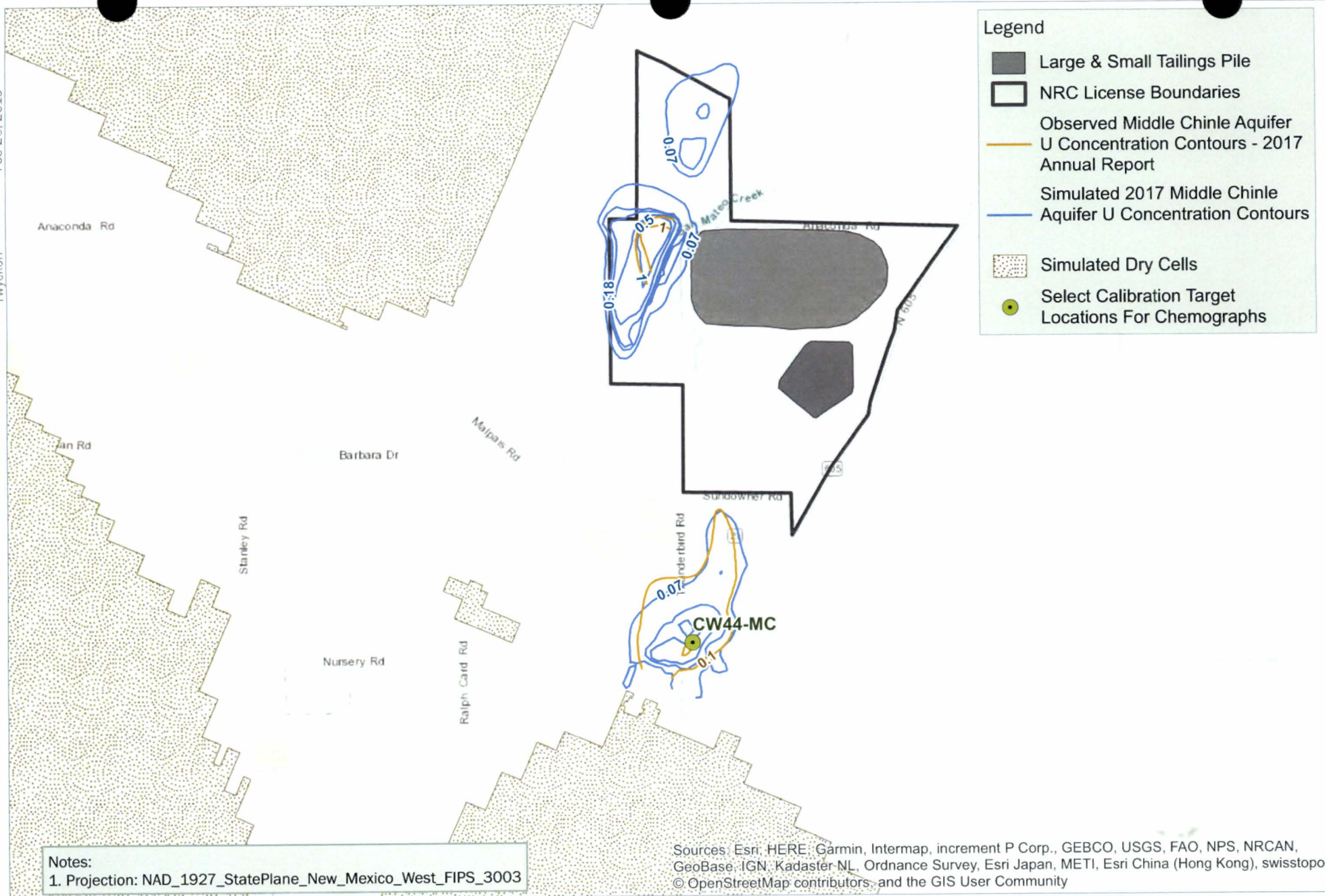


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Transport Modeling
Date: March 2019
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0 0.5 1 Miles



Figure 5-25
Upper Chinle Aquifer Simulated vs.
Observed 2017 Uranium
Concentration Contours

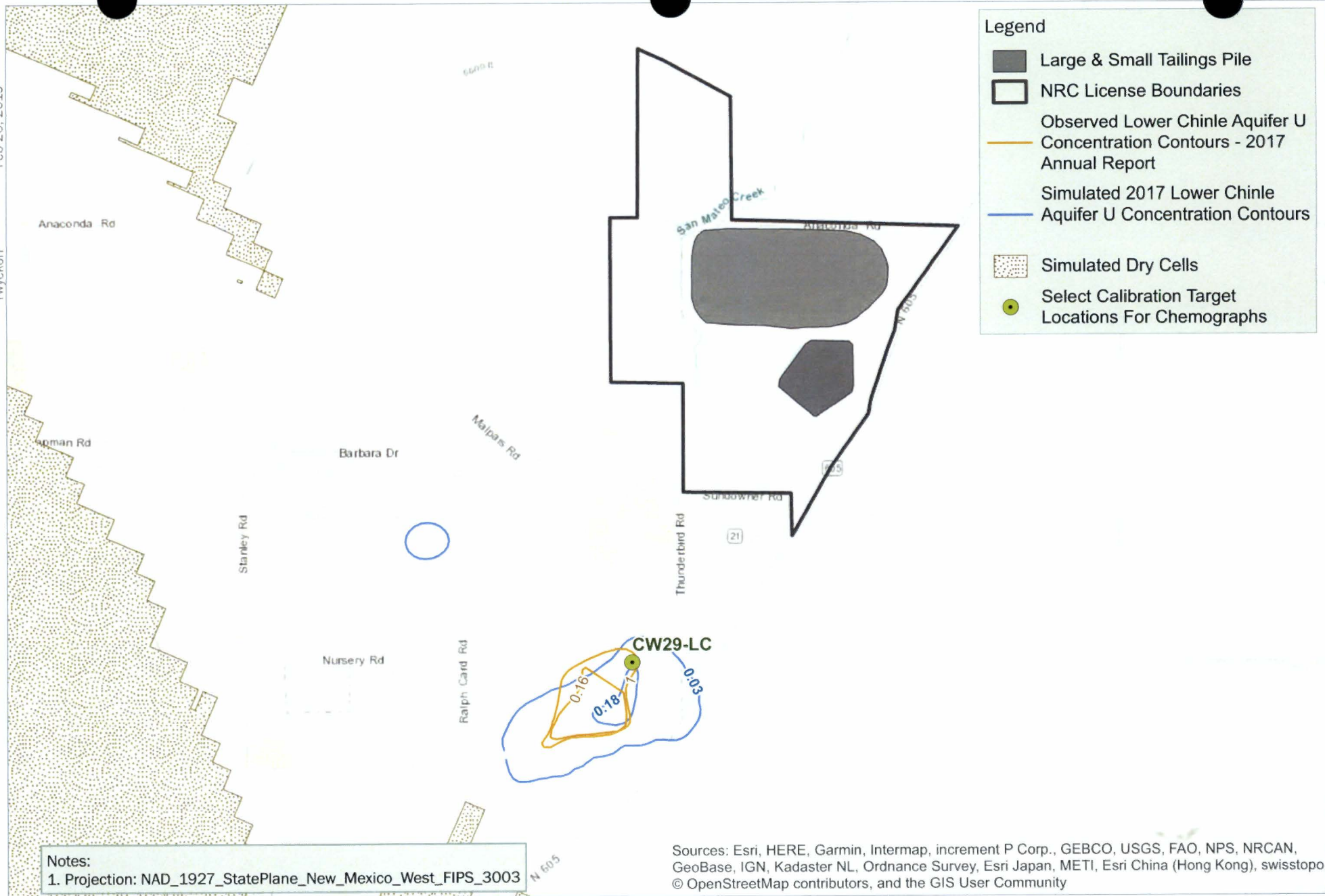


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Date: March 2019
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0 0.5 1 Miles



Figure 5-26
Middle Chinle Aquifer Simulated vs.
Observed 2017 Uranium
Concentration Contours

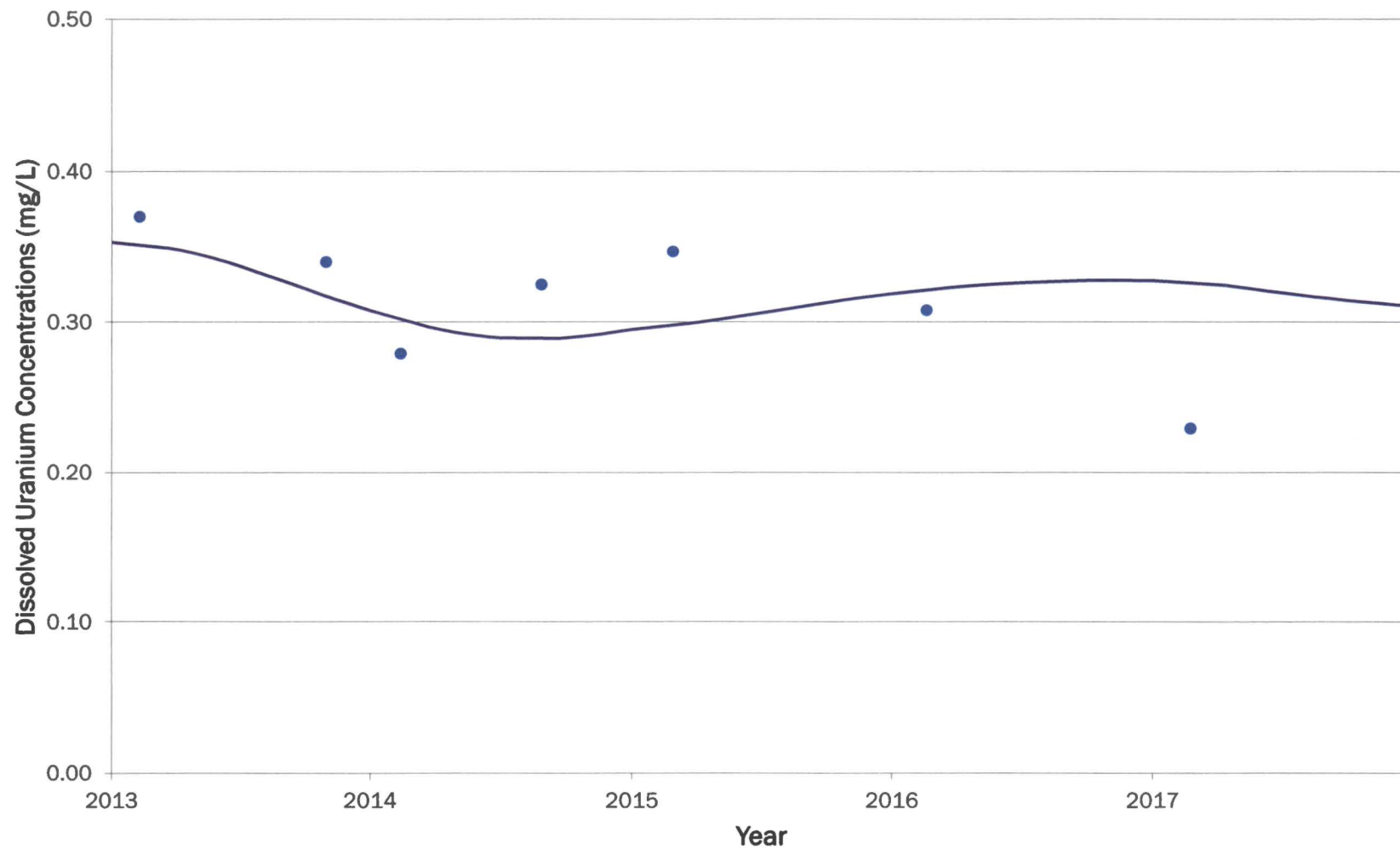


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Transport Modeling
Date: March 2019
Project: 152816

0 0.5 1 Miles



Figure 5-27
Lower Chinle Aquifer Simulated vs.
Observed 2017 Uranium
Concentration Contours

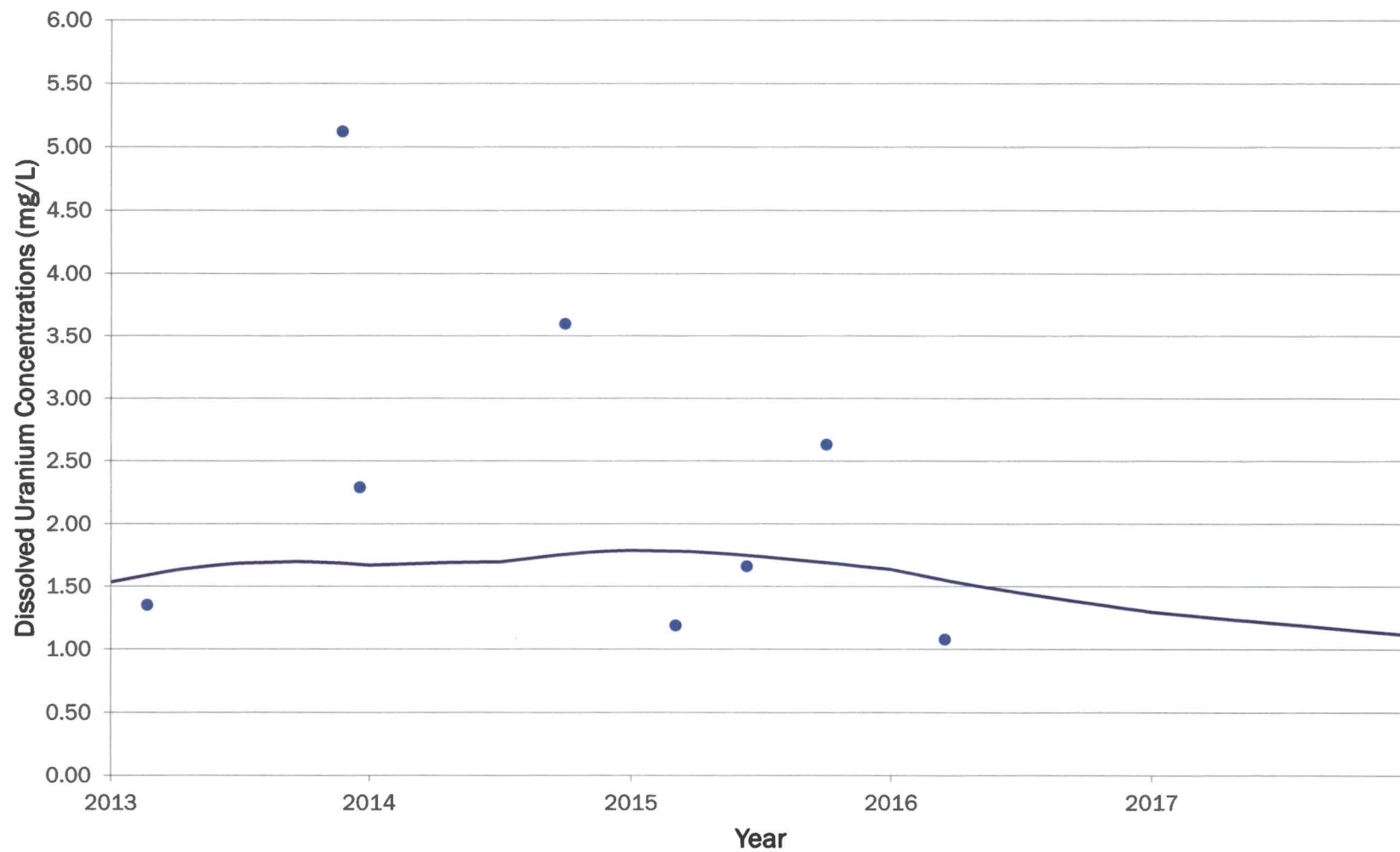


— Simulated U Concentrations • Well 0881-AI Observed U Concentrations



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Figure 5-28
Simulated versus Observed Uranium
Concentrations - Well 0881-AI

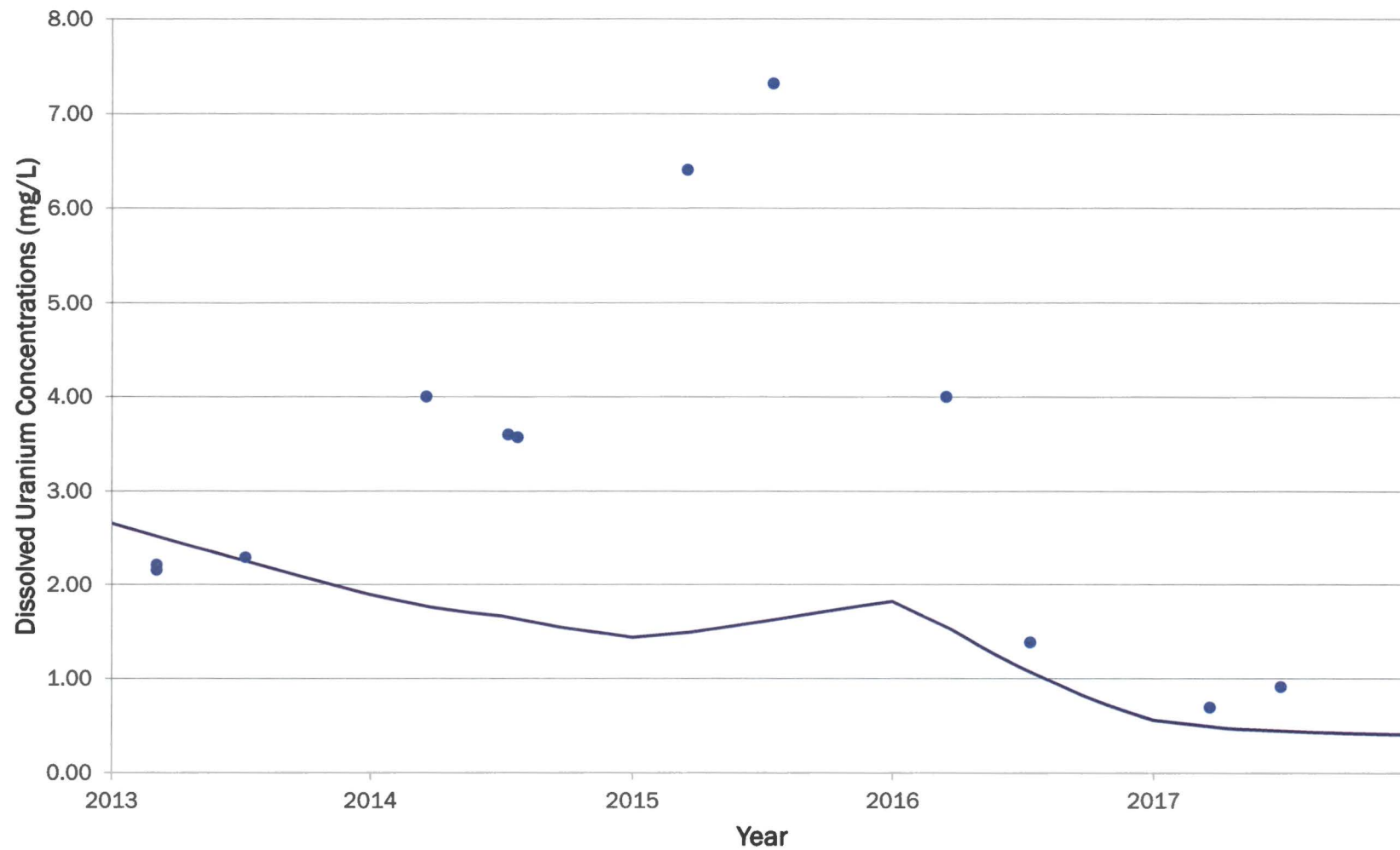


— Simulated U Concentrations • Well M9-AI Observed U Concentrations



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Figure 5-29
Simulated versus Observed Uranium
Concentrations - Well M9-AI

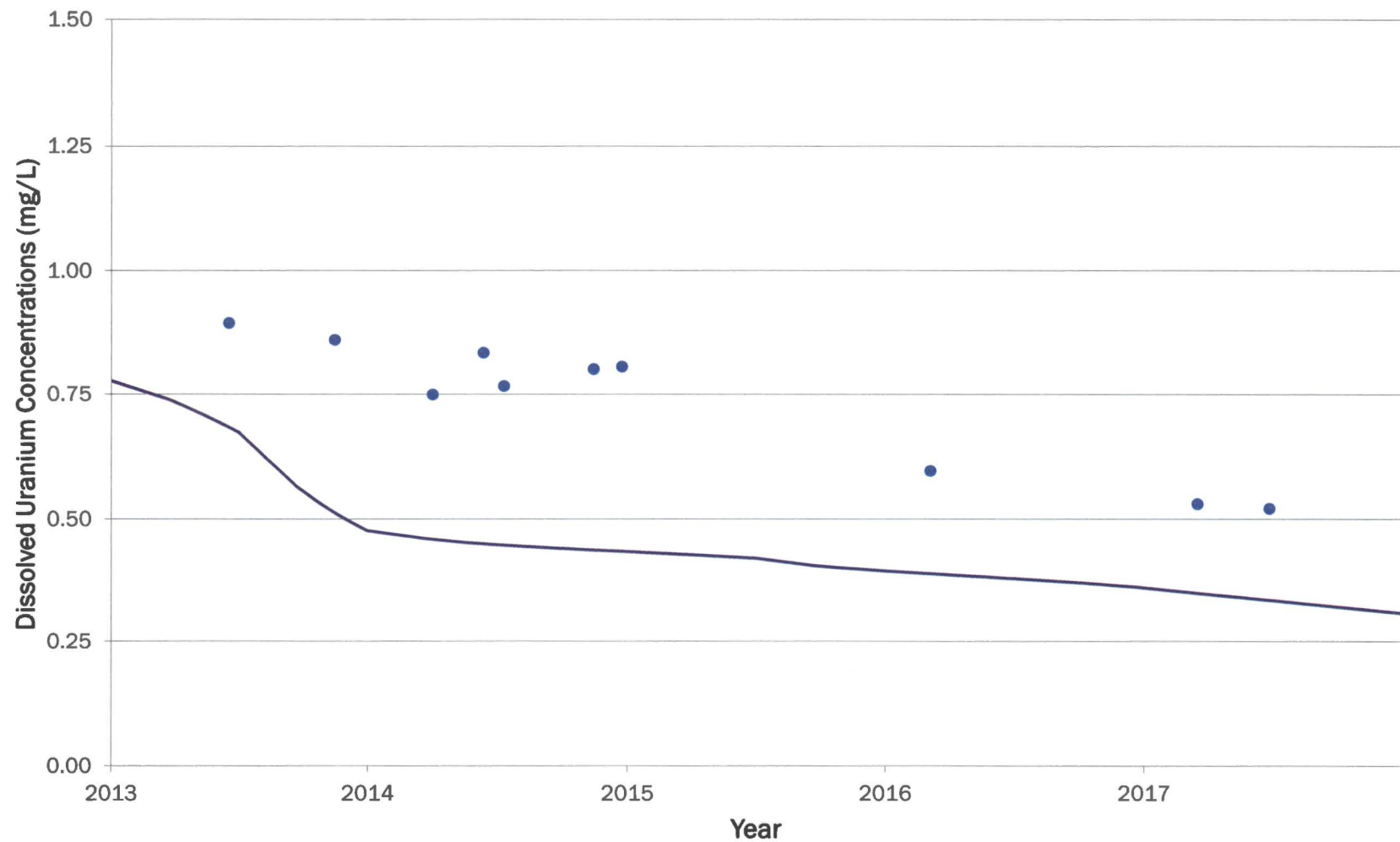


— Simulated U Concentrations • Well D1-AI Observed U Concentrations



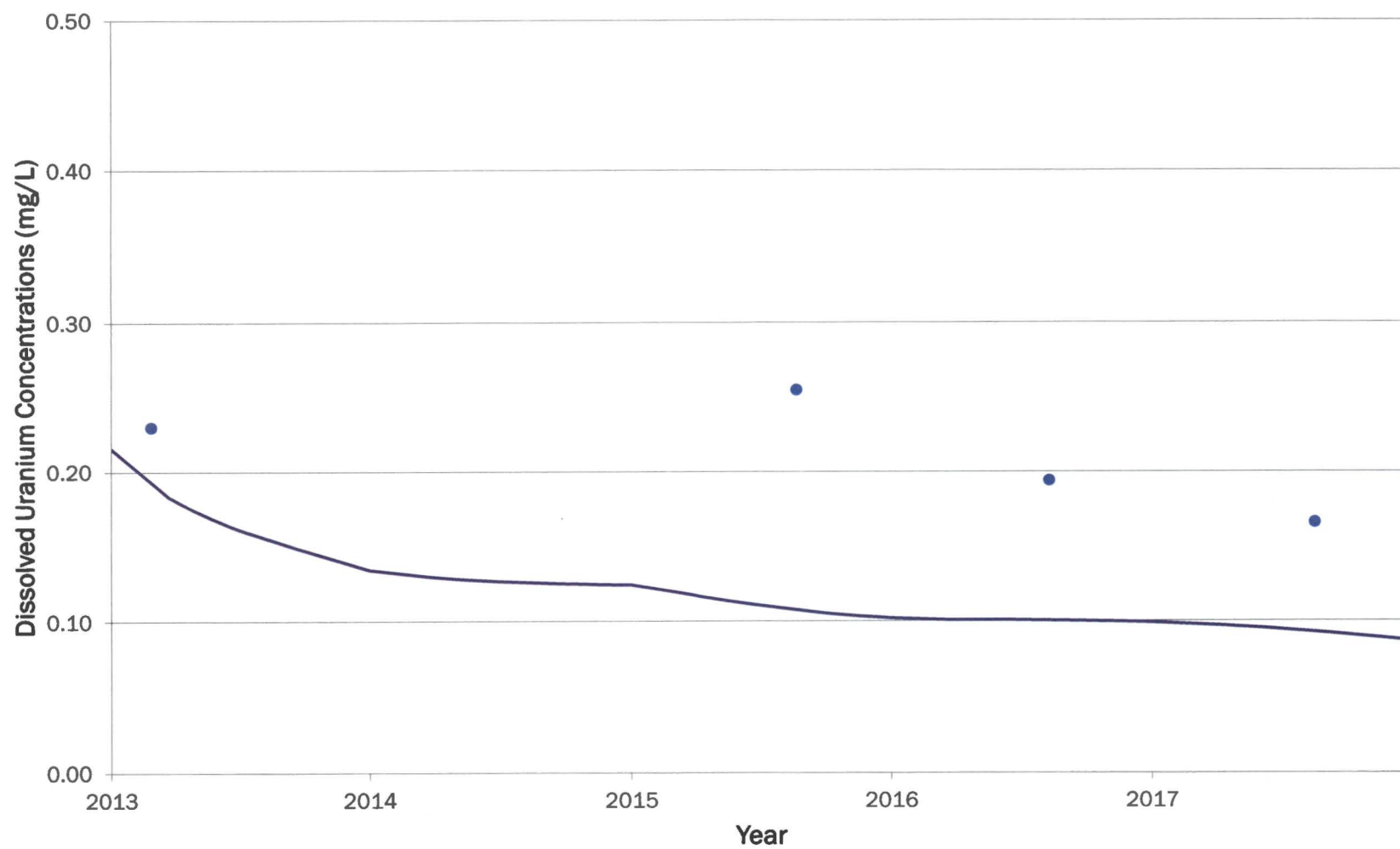
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Figure 5-30
Simulated versus Observed Uranium
Concentrations - Well D1-AI



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Figure 5-31
Simulated versus Observed Uranium
Concentrations - Well 0497-AI

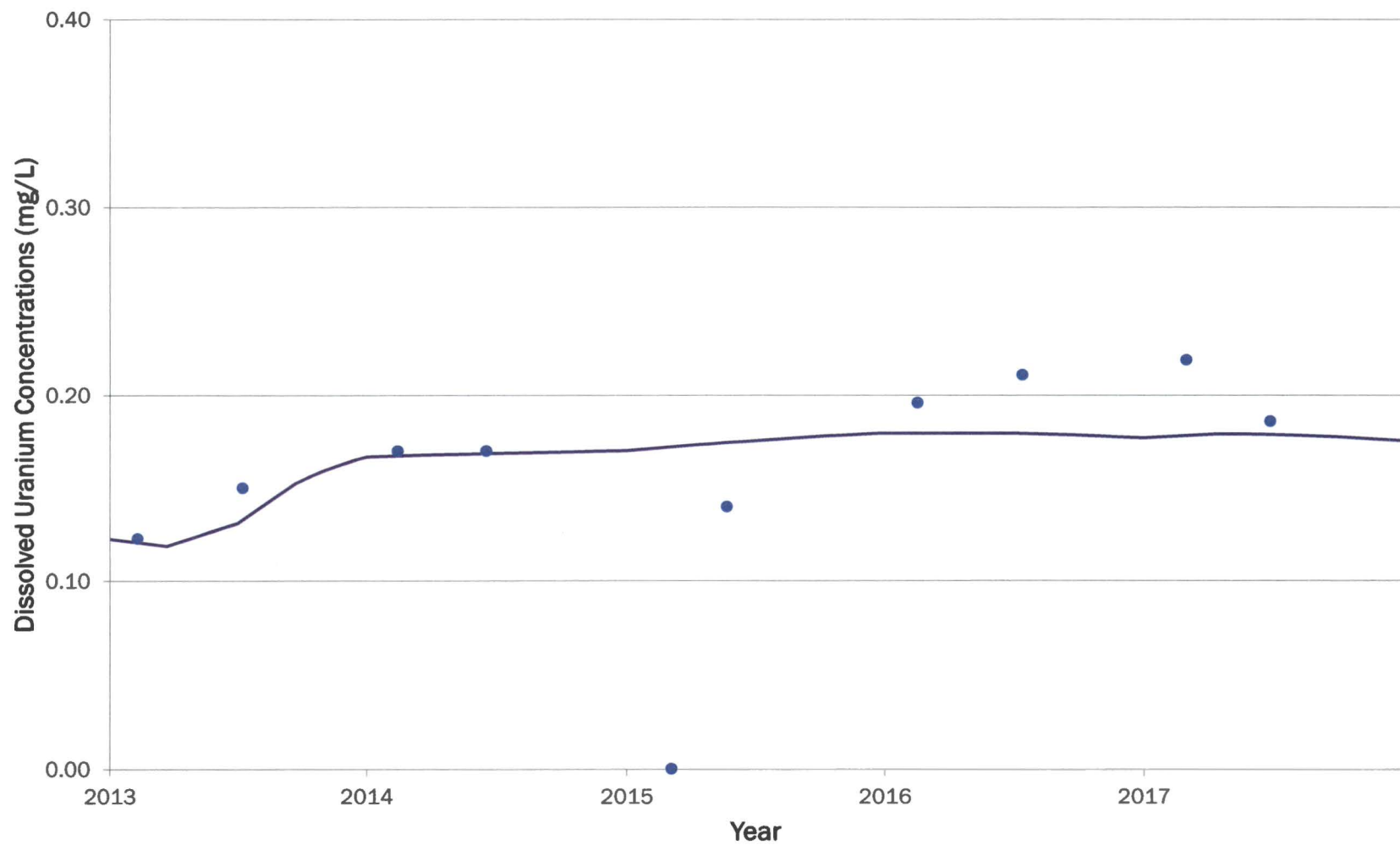


— Simulated U Concentrations • Well 0864-AI Observed U Concentrations



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Figure 5-32
Simulated versus Observed Uranium
Concentrations - Well 0864-AI

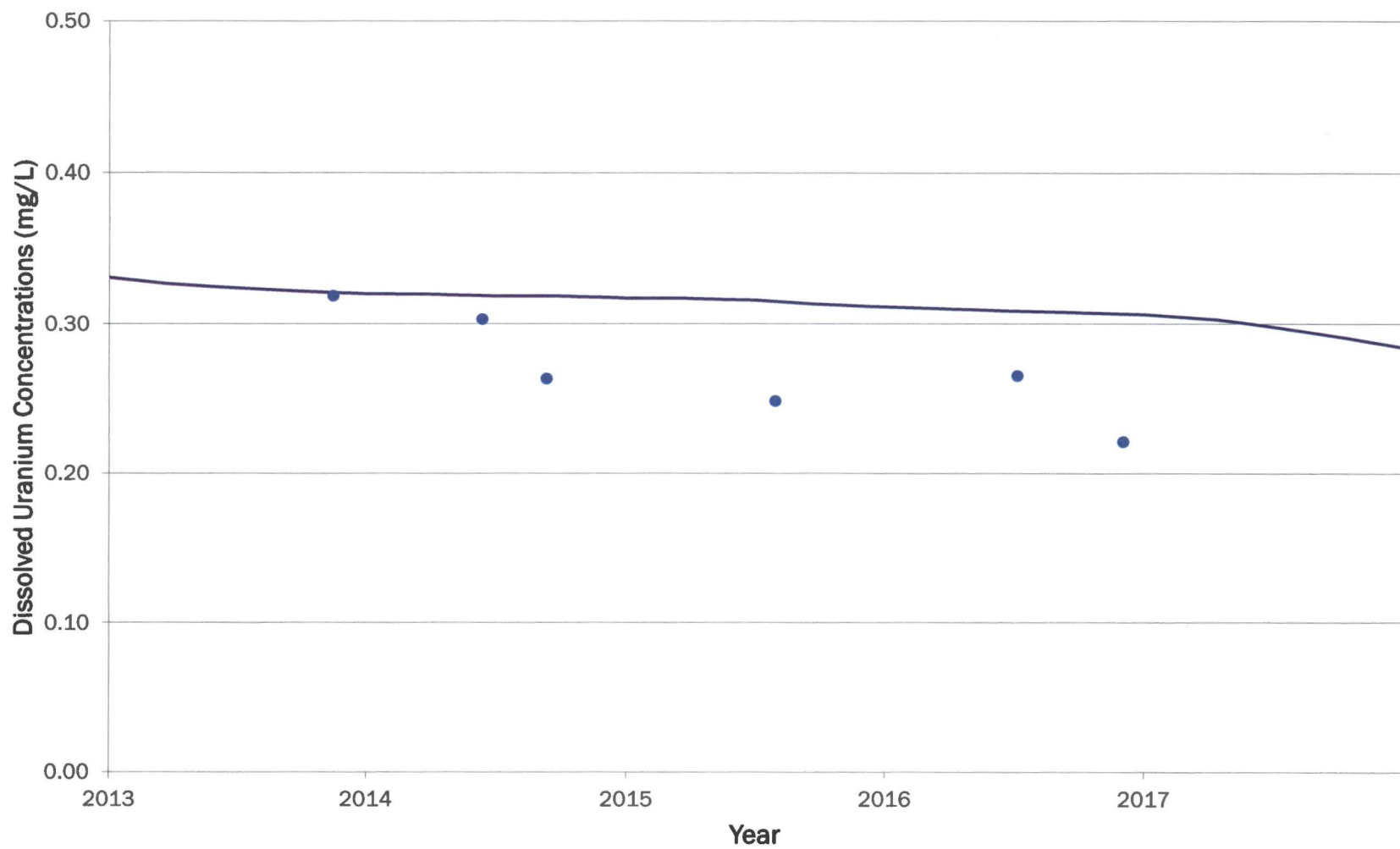


— Simulated U Concentrations • Well 0494-UC Observed U Concentrations



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Figure 5-33
Simulated versus Observed Uranium
Concentrations - Well 0494-UC

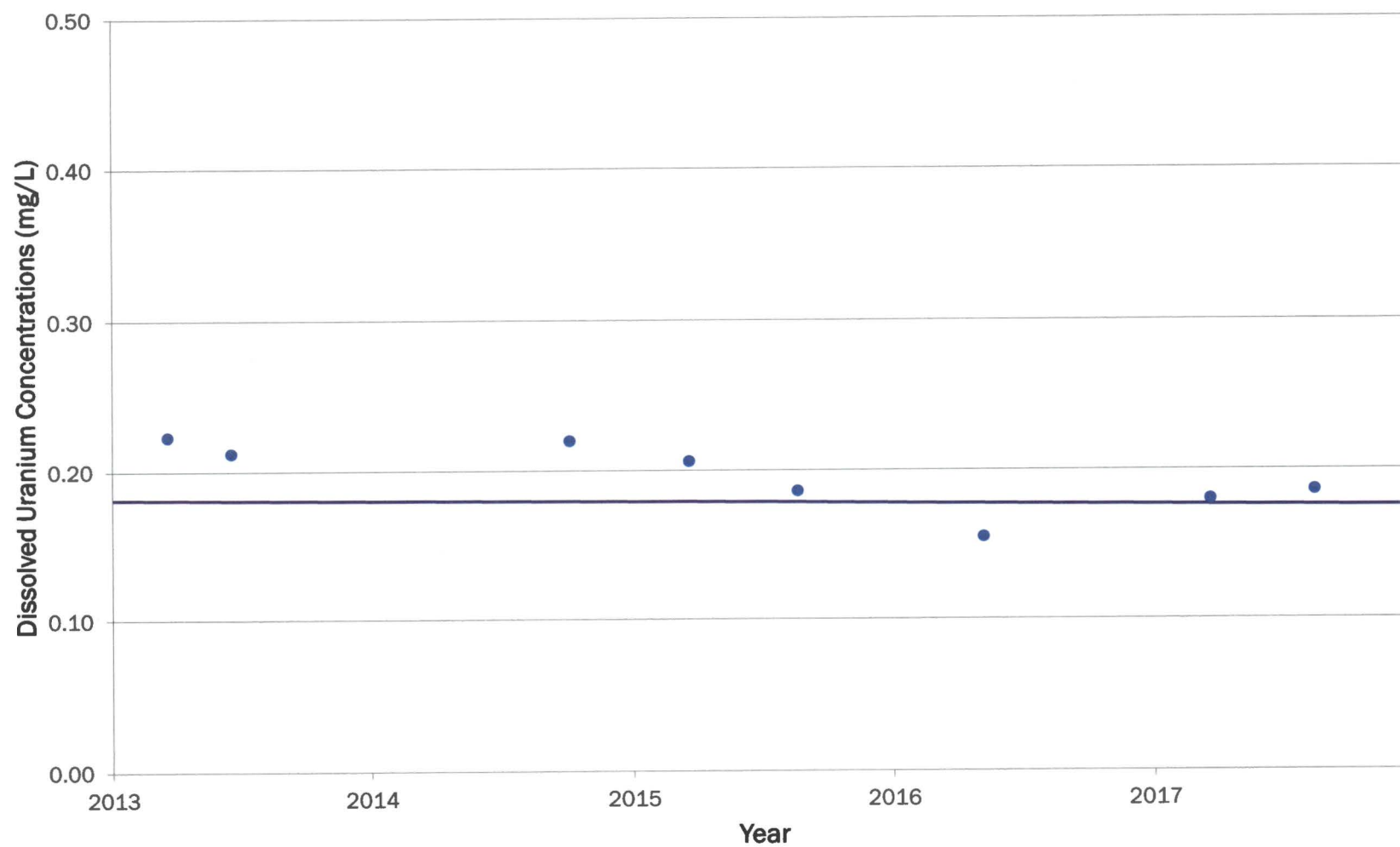


— Simulated U Concentrations • Well CW44-MC Observed U Concentrations



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Figure 5-34
Simulated versus Observed Uranium
Concentrations - Well CW44-MC

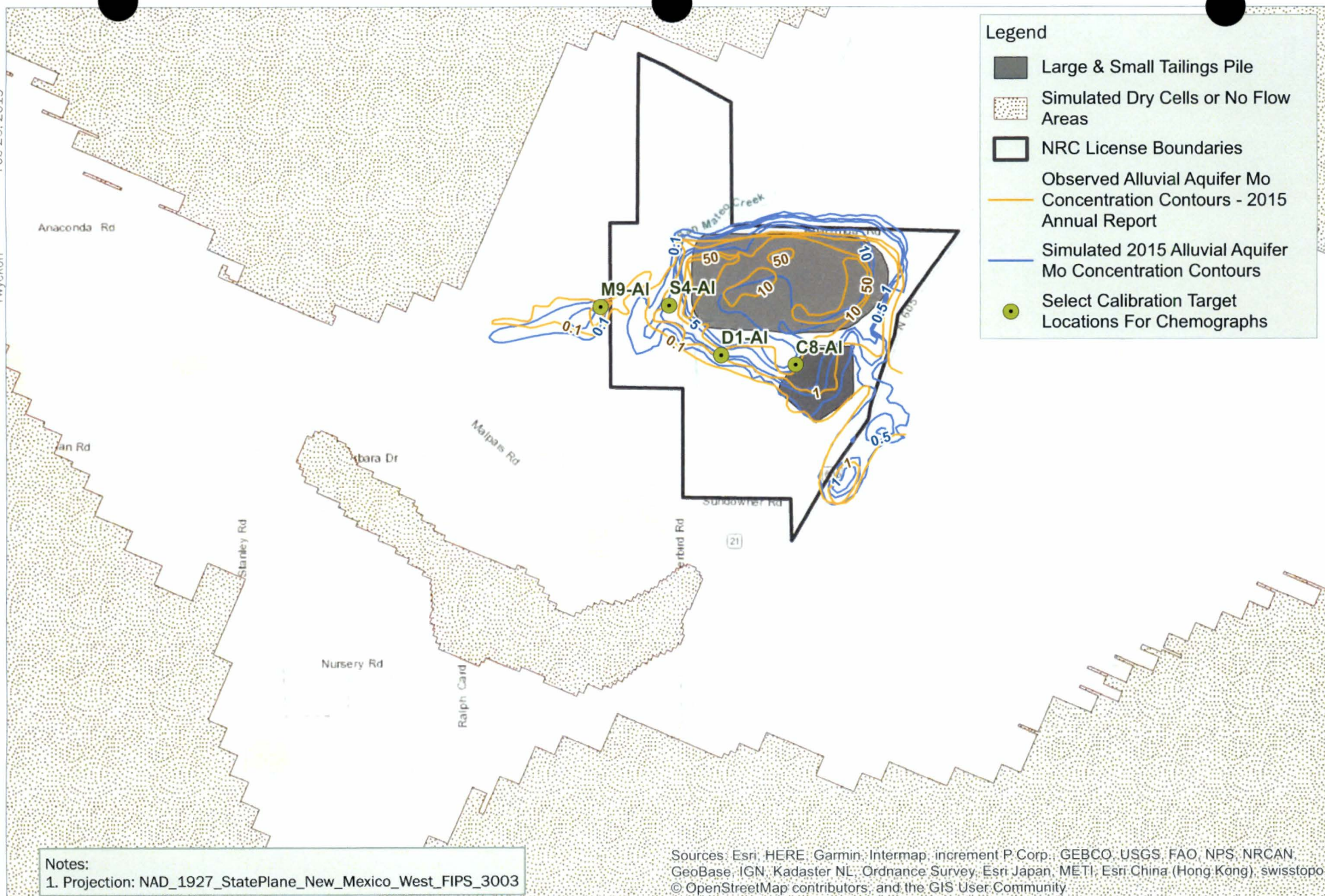


— Simulated U Concentrations • Well CW29-LC Observed U Concentrations



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Figure 5-35
Simulated versus Observed Uranium
Concentrations - Well CW29-LC

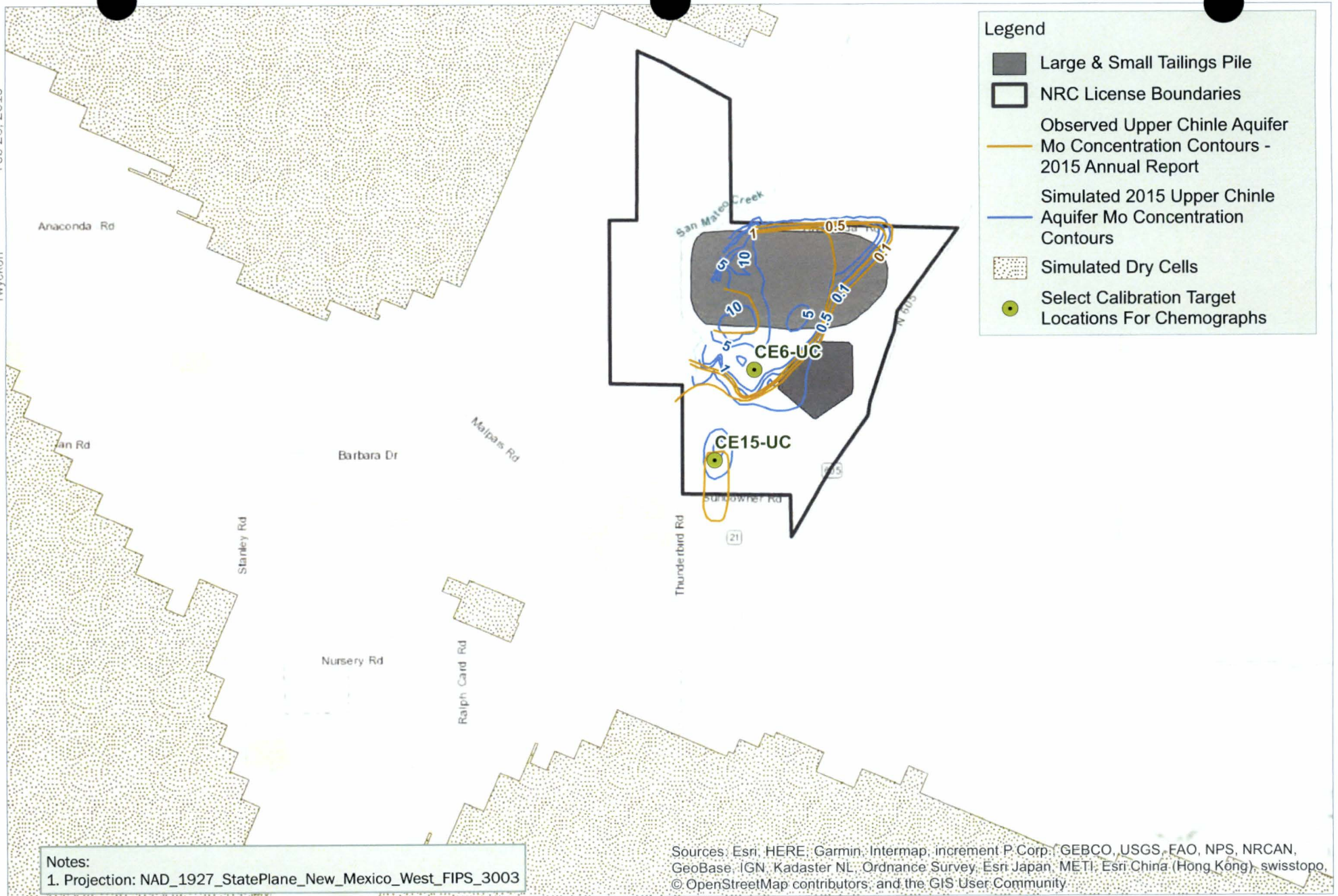


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Transport Modeling
Date: March 2019
Project: 152816

0 0.5 1 Miles



Figure 5-36
Alluvial Aquifer Simulated vs. Observed 2015
Molybdenum Concentration Contours

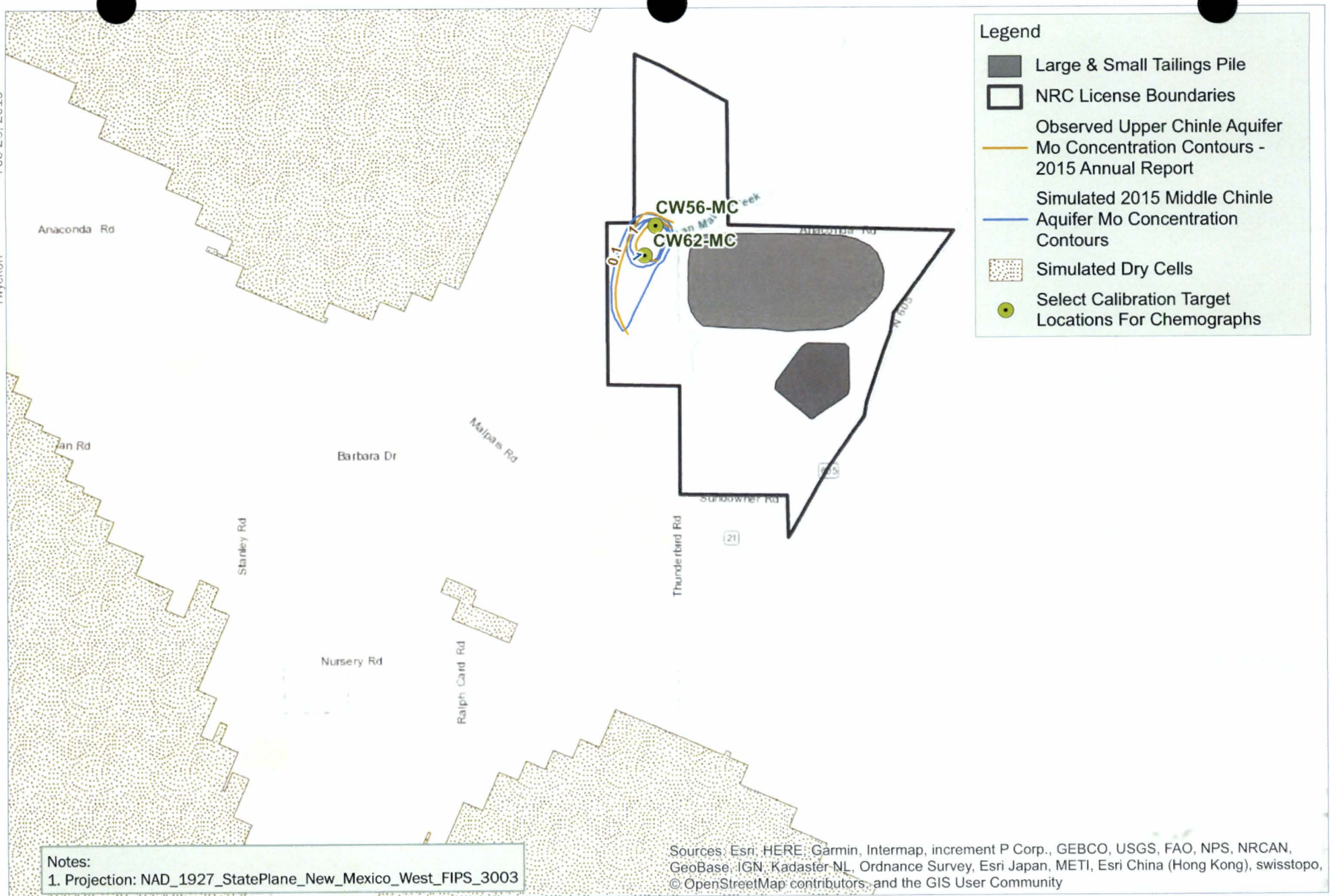


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Transport Modeling
Date: March 2019
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0 0.5 1 Miles



Figure 5-37
Upper Chinle Aquifer Simulated vs.
Observed 2015 Molybdenum
Concentration Contours

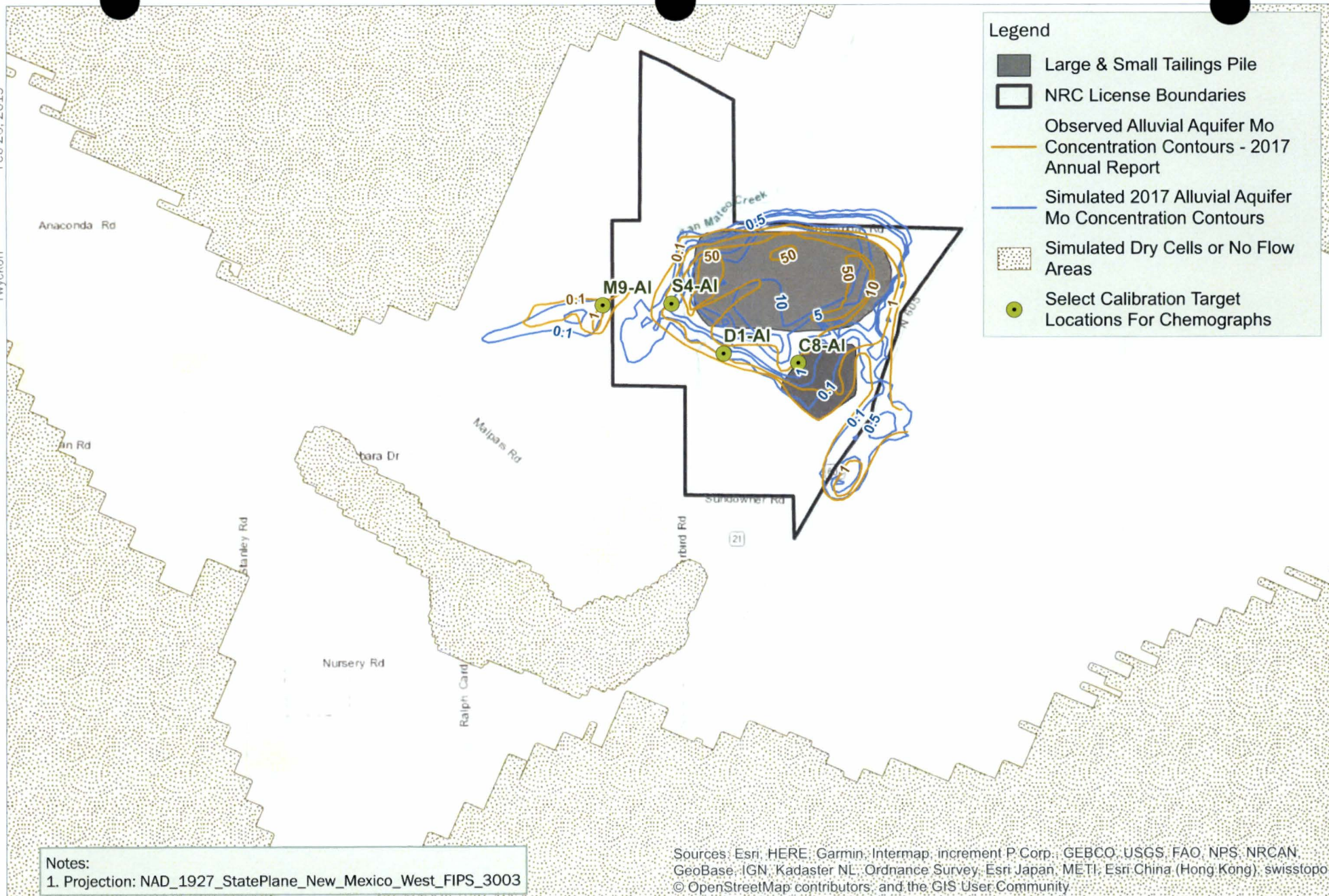


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Transport Modeling
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Project: 152816

0 0.5 1 Miles



Figure 5-38
Middle Chinle Aquifer Simulated 2015
Molybdenum Concentration Contours

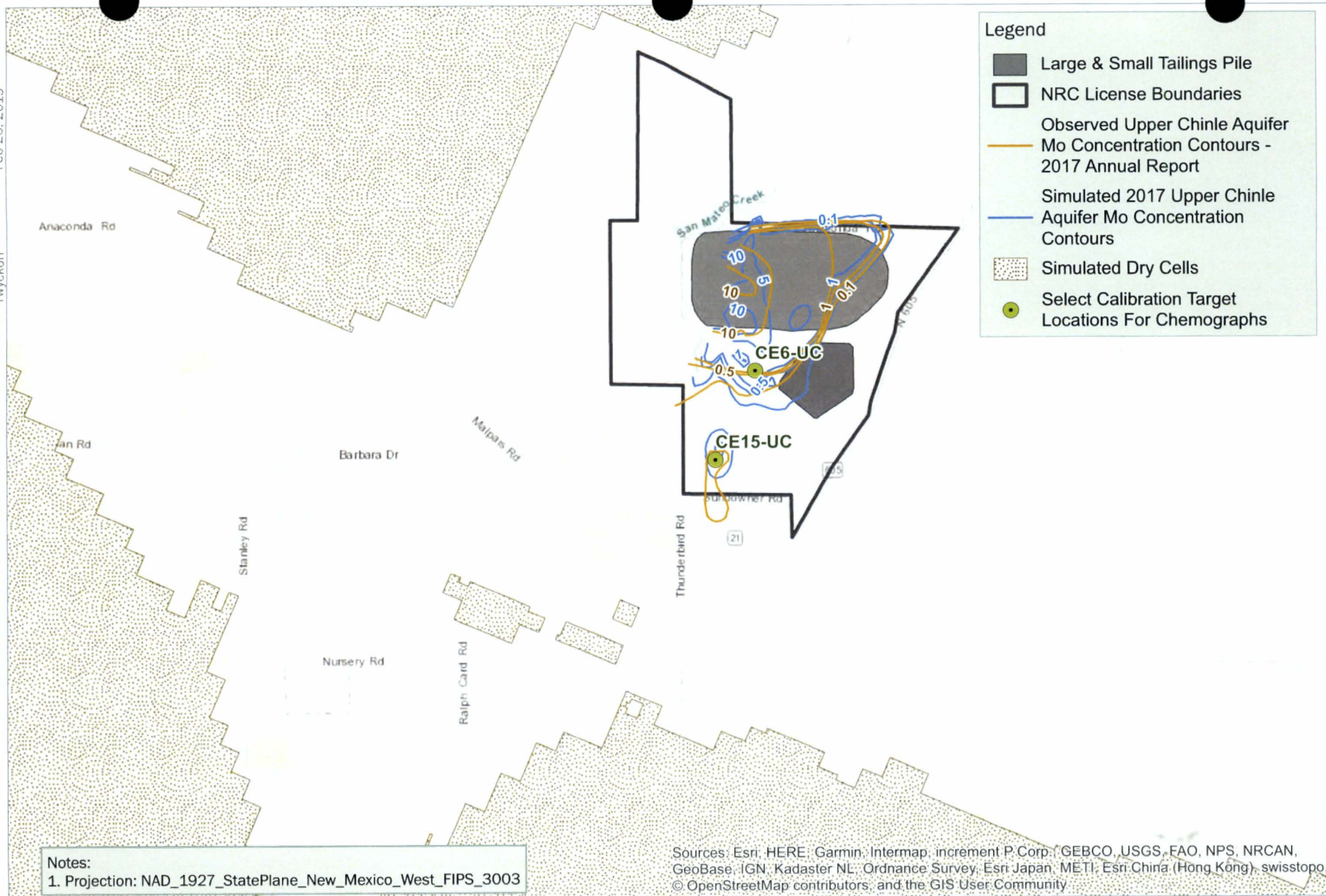


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Transport Modeling
Date: March 2019
Project: 152816

0 0.5 1 Miles



Figure 5-39
Alluvial Aquifer Simulated vs. Observed 2017
Molybdenum Concentration Contours

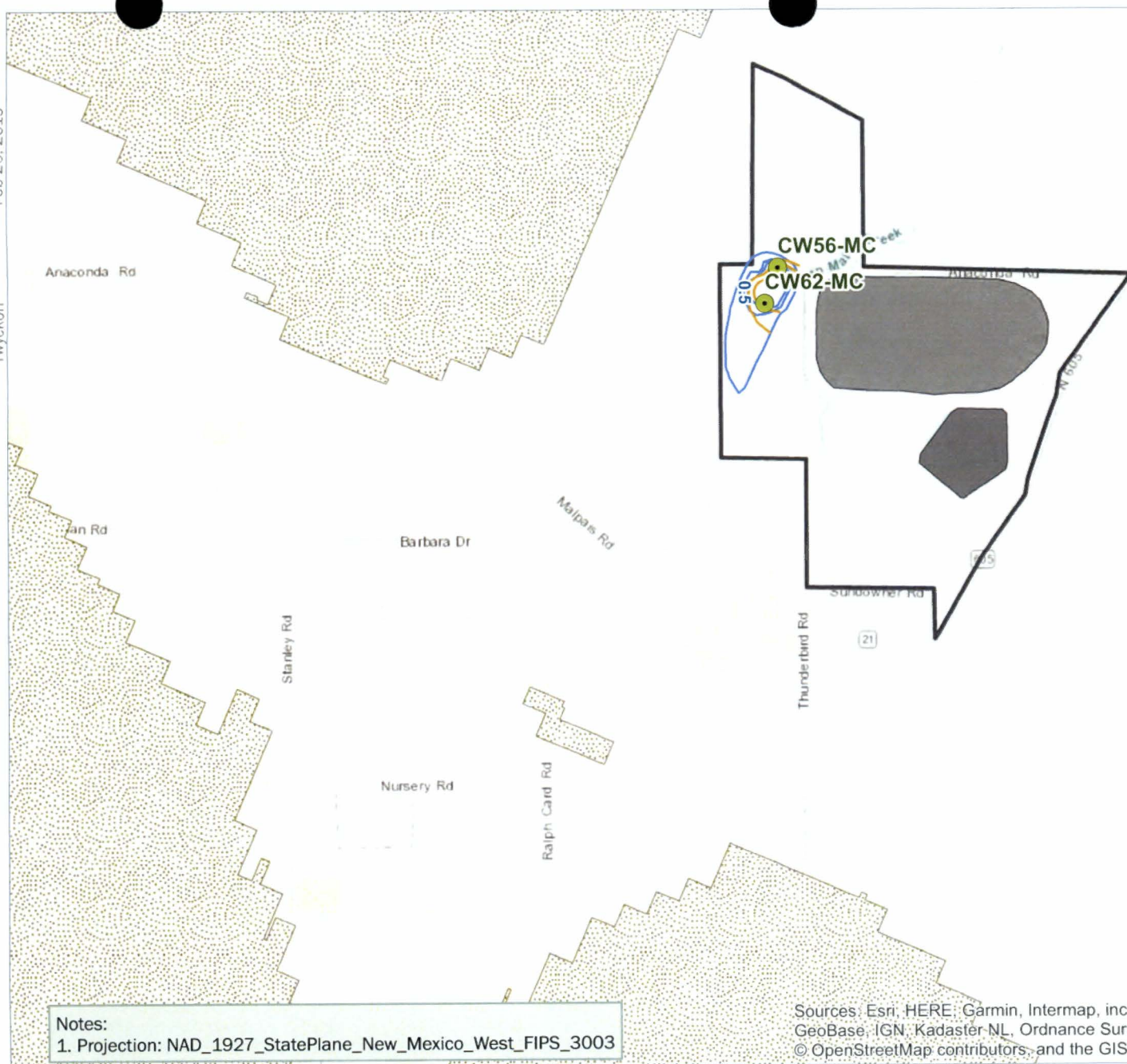


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Transport Modeling
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Project: 152816

0 0.5 1 Miles



Figure 5-40
Upper Chinle Aquifer Simulated vs.
Observed 2017 Molybdenum
Concentration Contours



Legend

- Large & Small Tailings Pile
- NRC License Boundaries
- Observed Upper Chinle Aquifer Mo Concentration Contours - 2017 Annual Report
- Simulated 2017 Middle Chinle Aquifer Mo Concentration Contours
- Simulated Dry Cells
- Select Calibration Target Locations For Chemographs

Notes:

1. Projection: NAD_1927_StatePlane_New_Mexico_West_FIPS_3003

Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, © OpenStreetMap contributors, and the GIS User Community

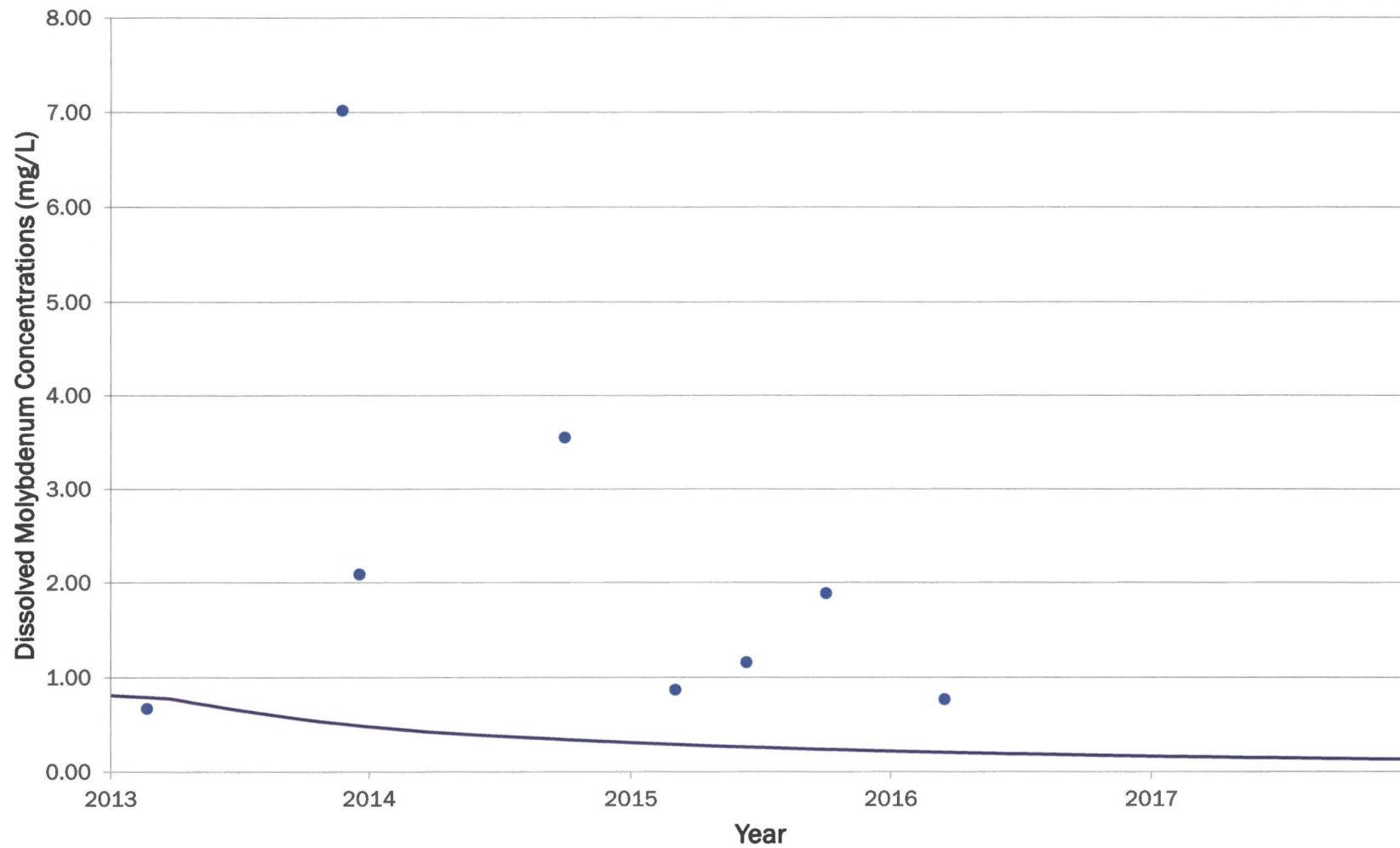


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 Project: 152816

0 0.5 1
 Miles



Figure 5-41
Middle Chinle Aquifer Simulated 2017
Molybdenum Concentration Contours

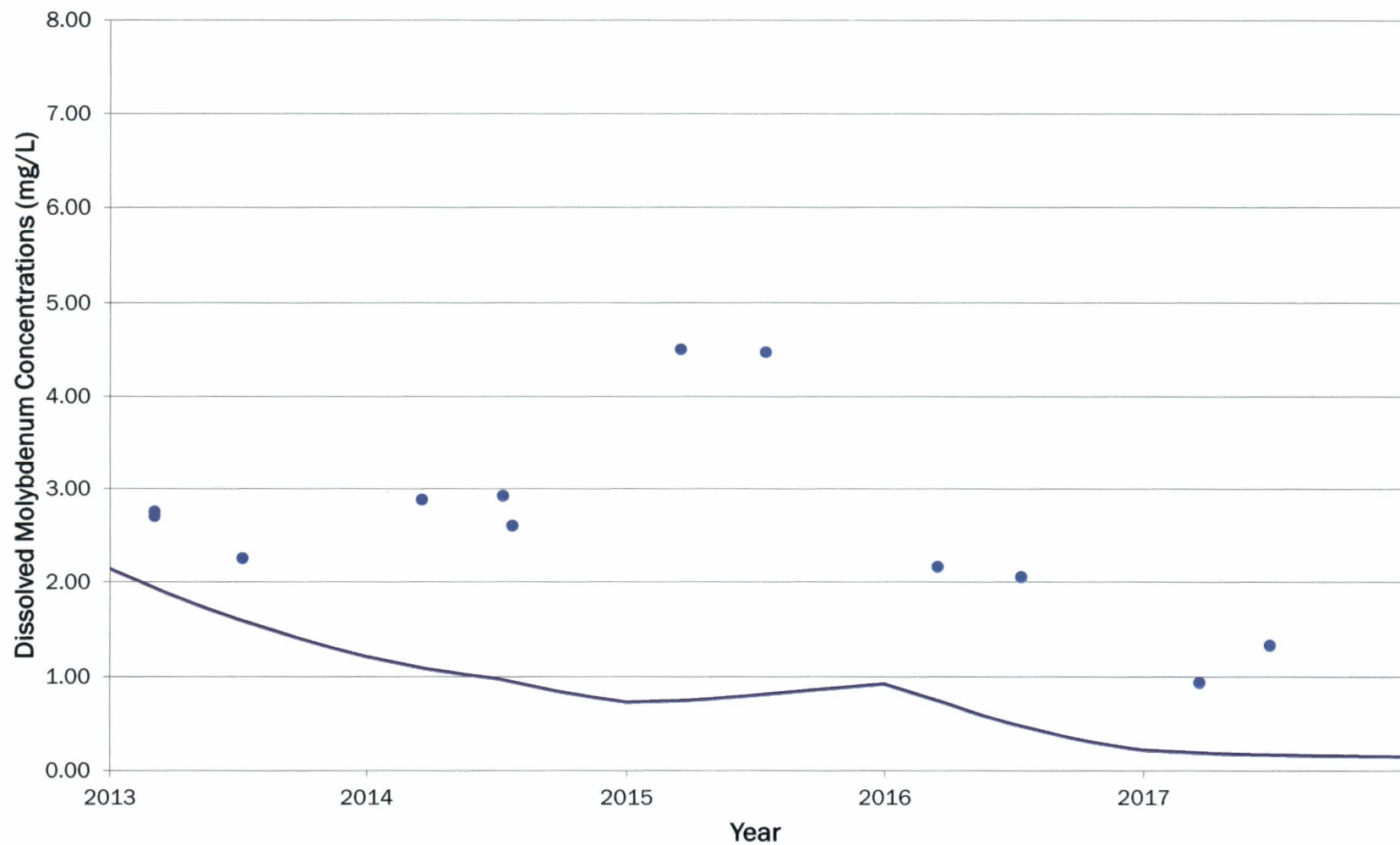


— Simulated Mo Concentrations • Well M9-AI Observed Mo Concentrations



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Figure 5-42
Simulated versus Observed Molybdenum Concentrations - Well M9-AI

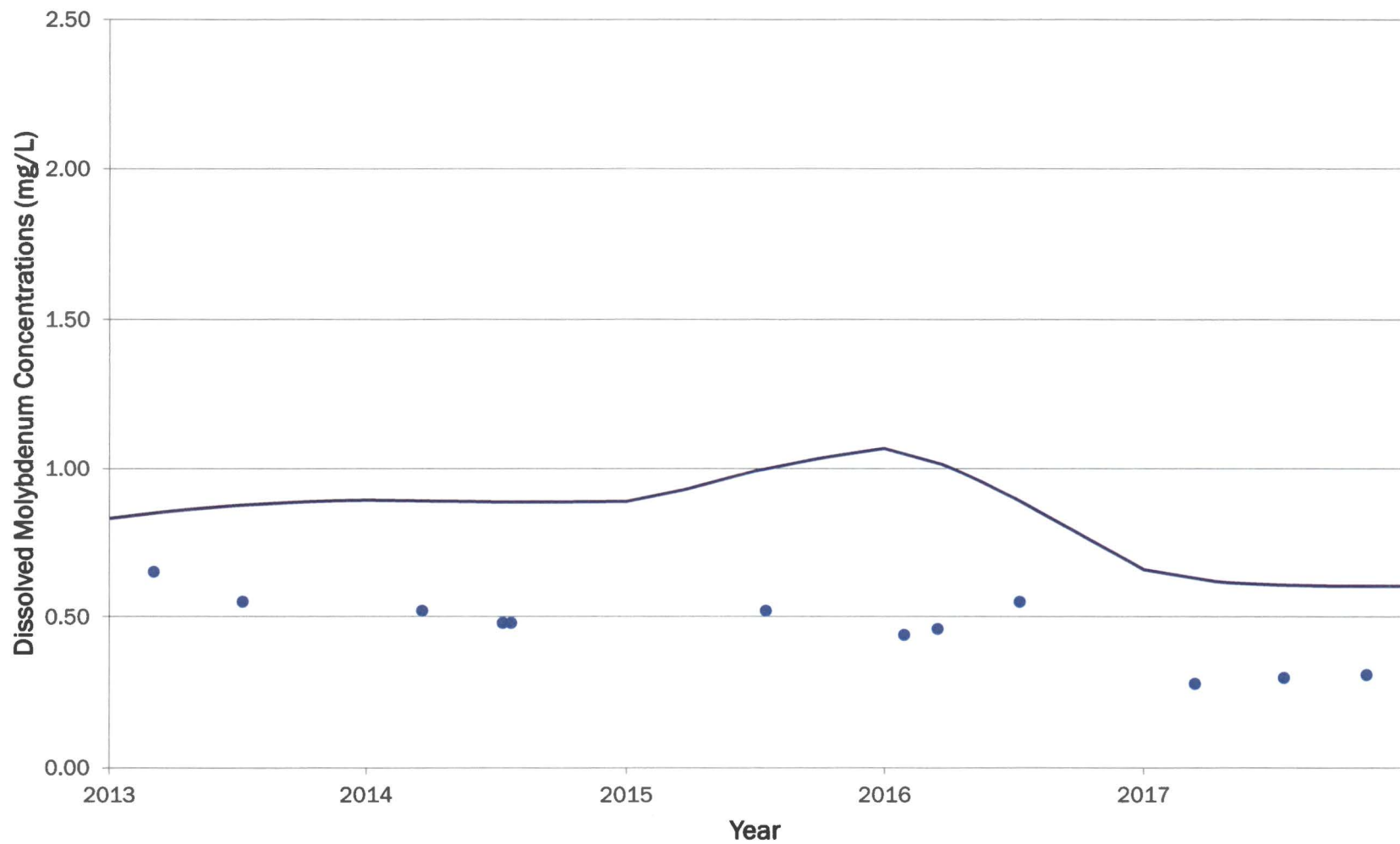


— Simulated Mo Concentrations • Well D1-AI Observed Mo Concentrations



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Figure 5-43
Simulated versus Observed Molybdenum
Concentrations - Well D1-AI

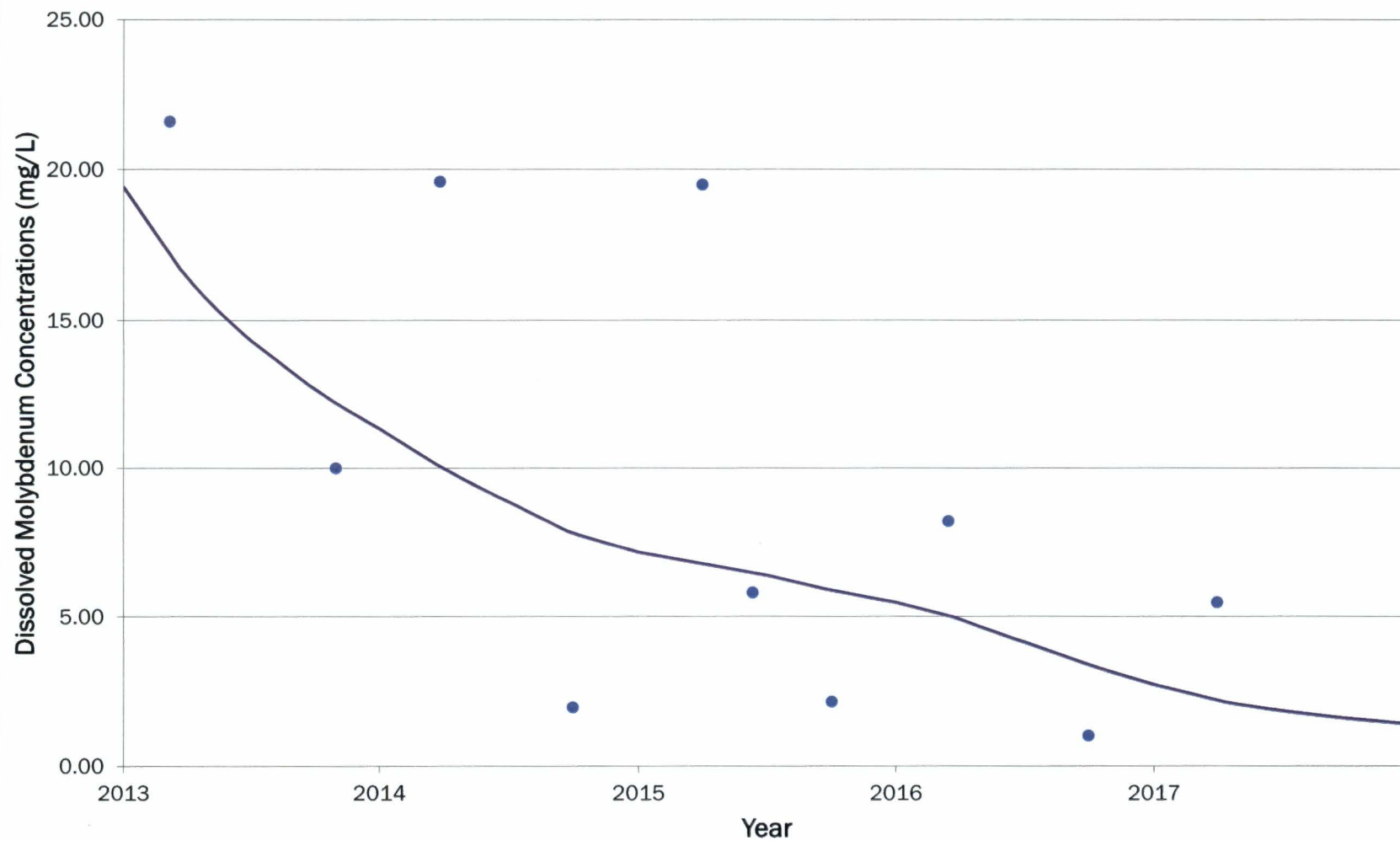


— Simulated Mo Concentrations • Well S4-AI Observed Mo Concentrations



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Project: 152816

Figure 5-44
Simulated versus Observed Molybdenum Concentrations - Well S4-AI

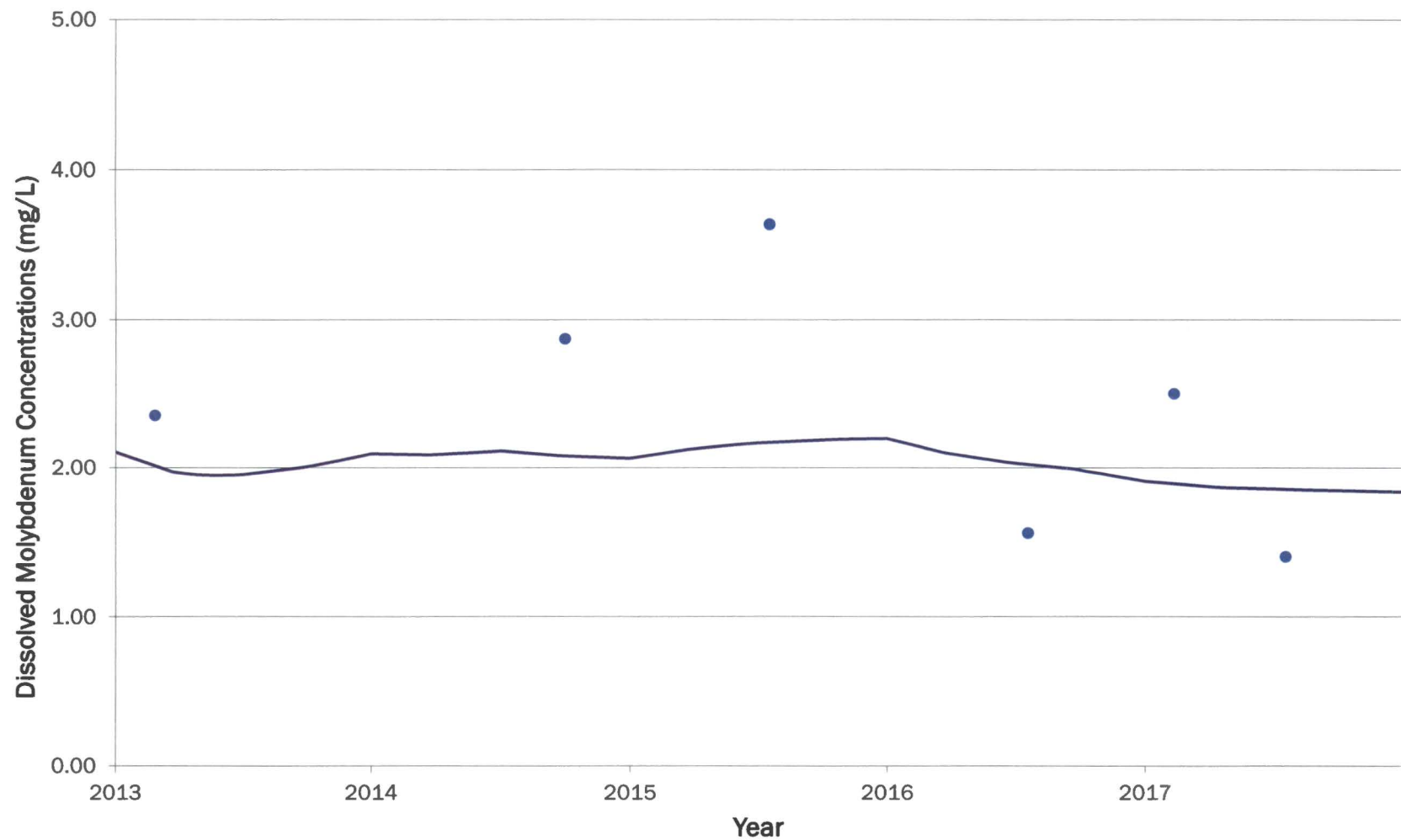


— Simulated Mo Concentrations • Well C8-AI Observed Mo Concentrations



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Groundwater Fate and Transport Modeling
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Project: 152816

Figure 5-44
Simulated versus Observed Molybdenum
Concentrations - Well C8-AI

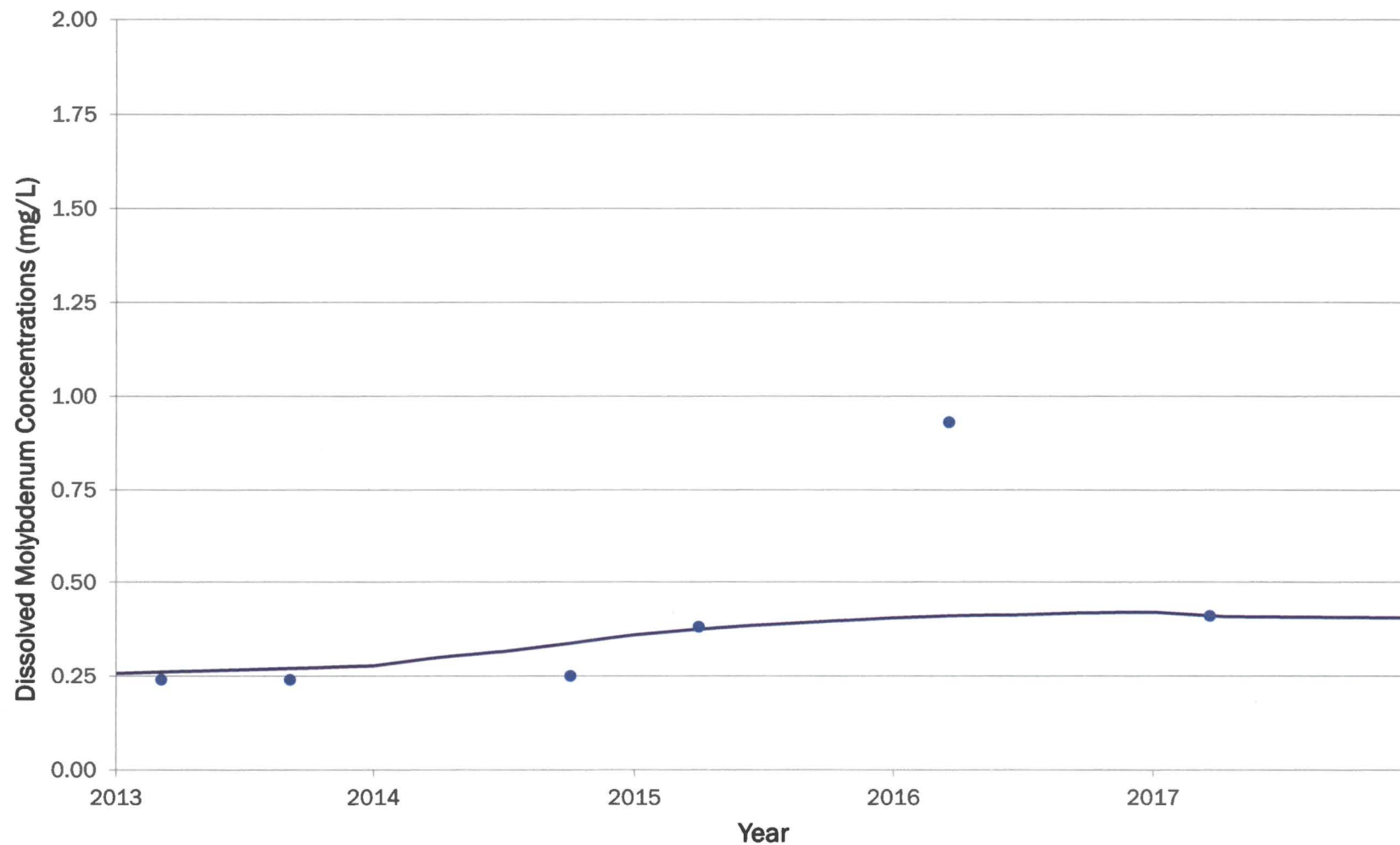


— Simulated Mo Concentrations • Well CE6-UC Observed Mo Concentrations



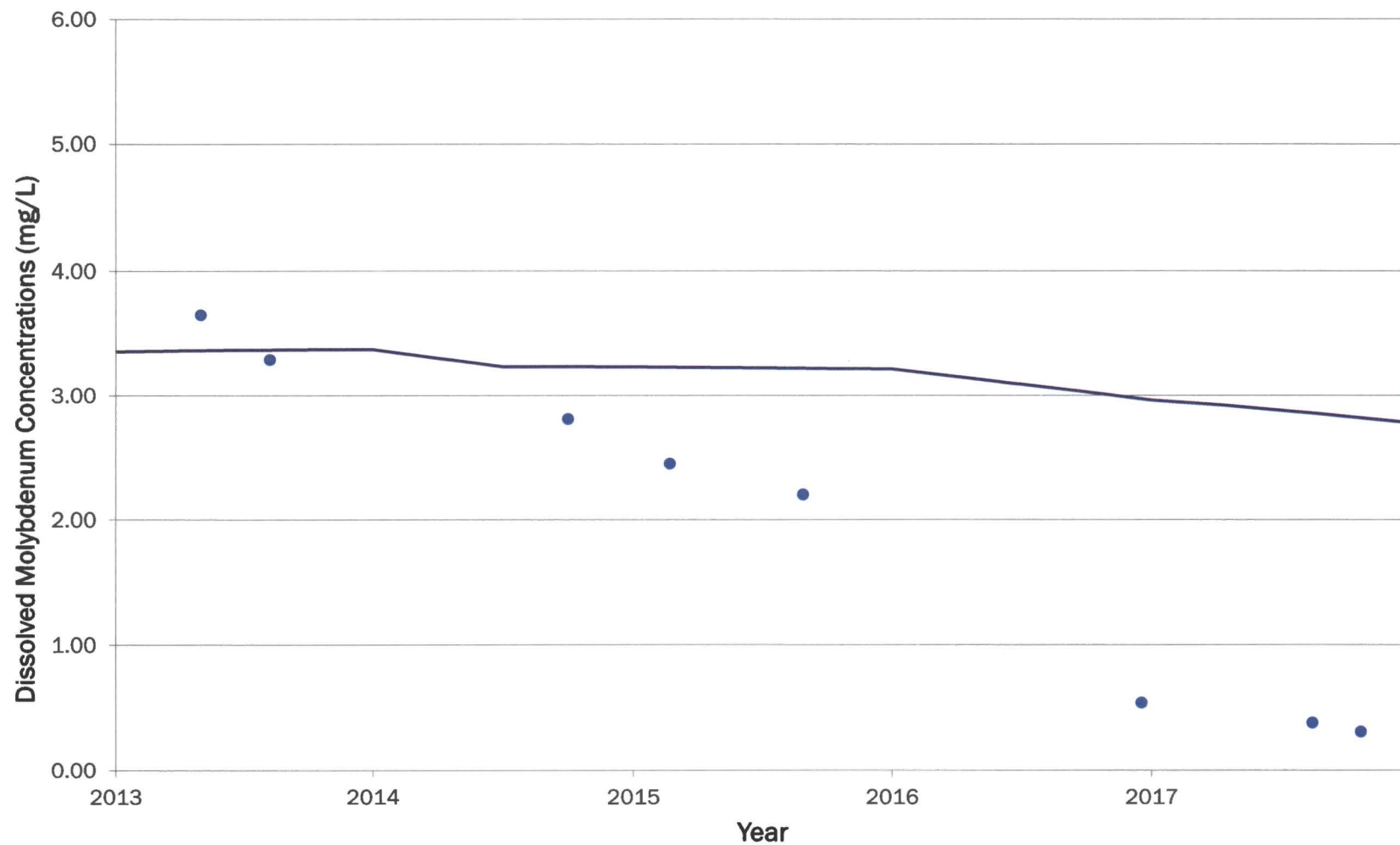
Homestake Mining Company
Grants Reclamation Project
Groundwater Fate and Transport Modeling
Date: March 2019
Project: 152816

Figure 5-46
Simulated versus Observed Molybdenum
Concentrations - Well CE6-UC



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Groundwater Fate and Transport Modeling
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Project: 152816

Figure 5-47
Simulated versus Observed Molybdenum
Concentrations - Well CE15-UC

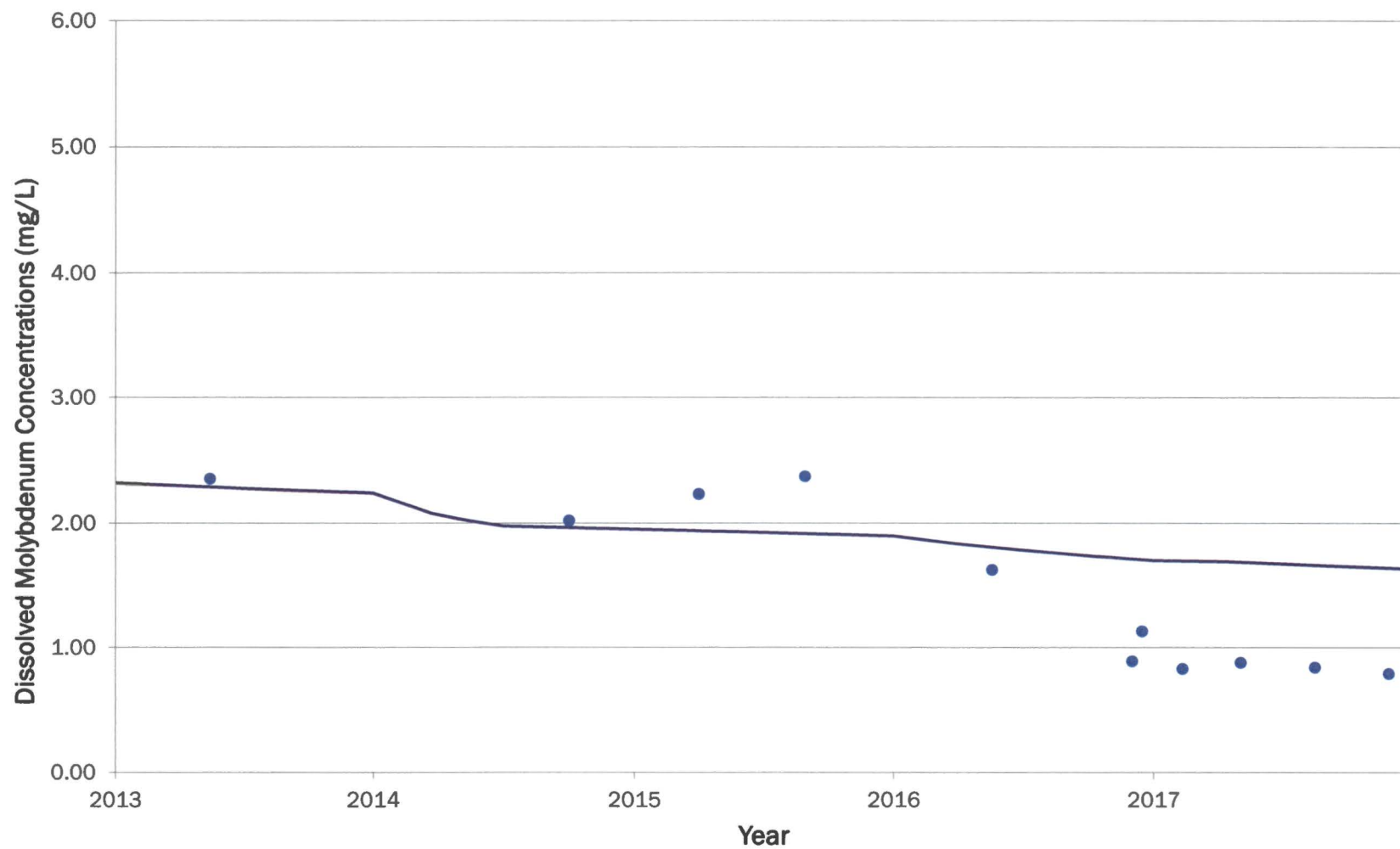


— Simulated Mo Concentrations • Well CW56-MC Observed Mo Concentrations



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Grants Reclamation Project
Groundwater Fate and Transport Modeling
Date: March 2019
Project: 152816

Figure 5-48
Simulated versus Observed Molybdenum
Concentrations - Well CW56-MC

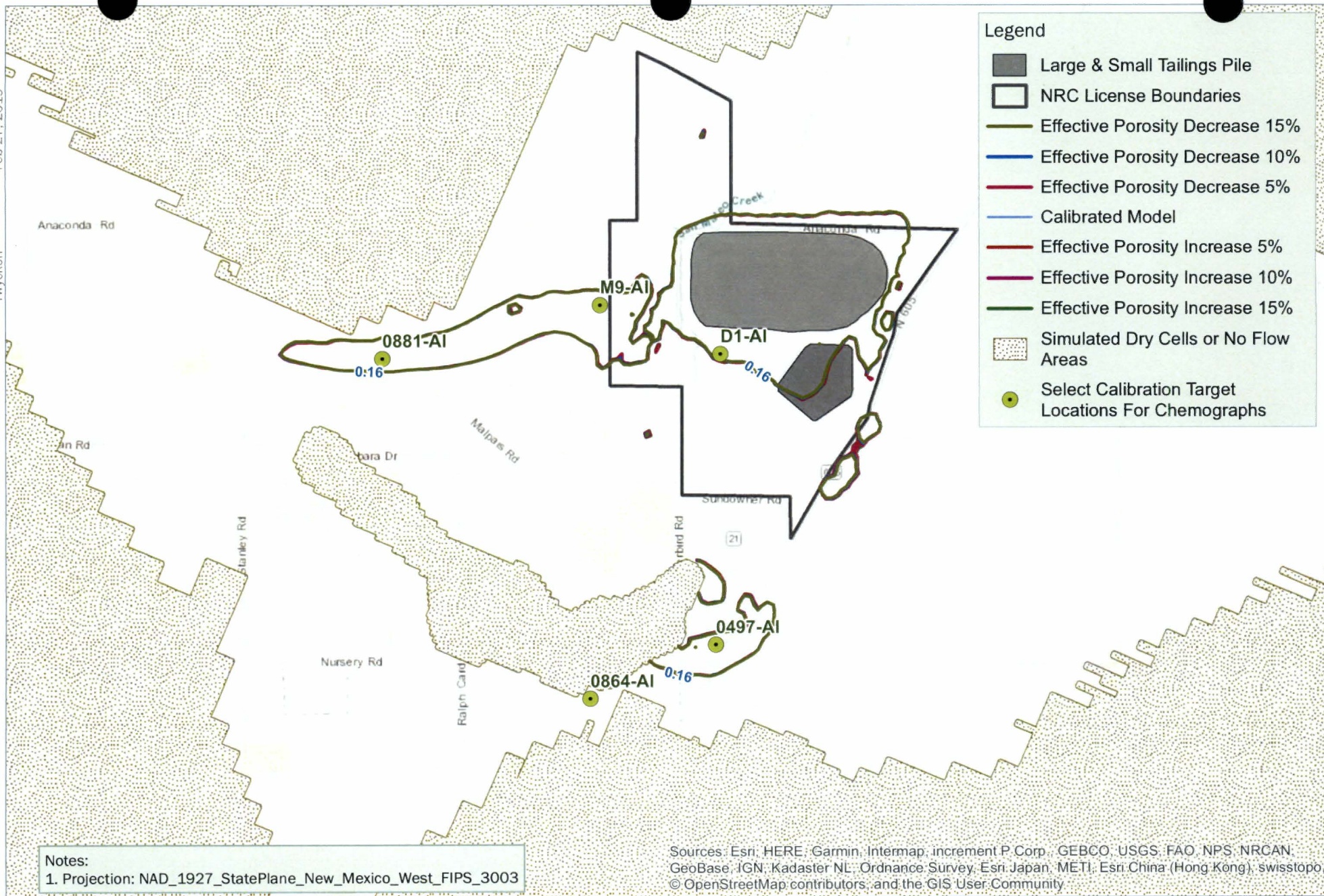


— Simulated Mo Concentrations • Well CW62-MC Observed Mo Concentrations



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Grants Reclamation Project
Groundwater Fate and Transport Modeling
Date: March 2019
Project: 152816

Figure 5-49
Simulated versus Observed Molybdenum
Concentrations - Well CW62-MC

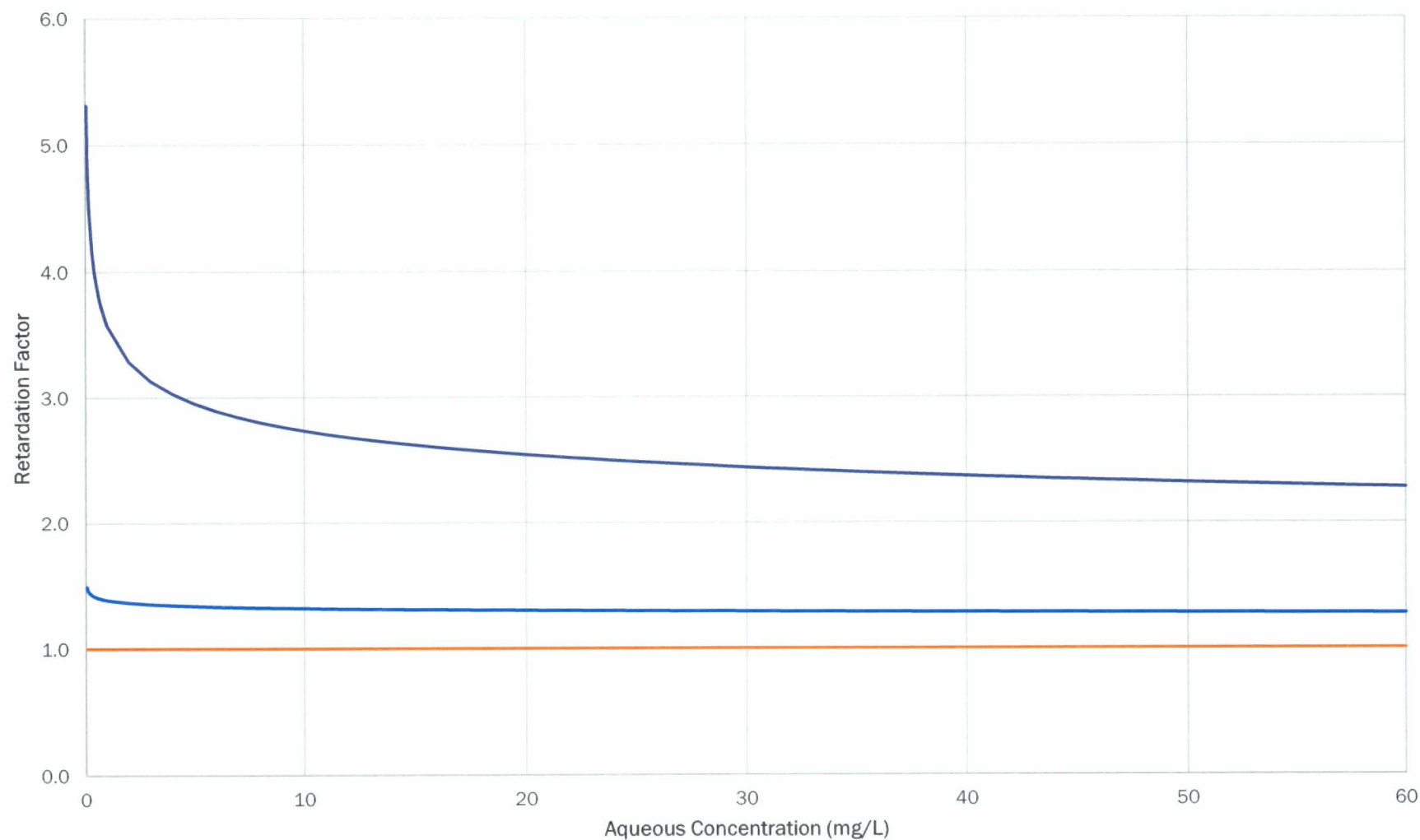


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Transport Modeling
Date: March 2019
Project: 152816

0 0.5 1 Miles



Figure 6-1
Effective Porosity Sensitivity
2017 Alluvial Aquifer Uranium
0.16 mg/L Concentration Contours



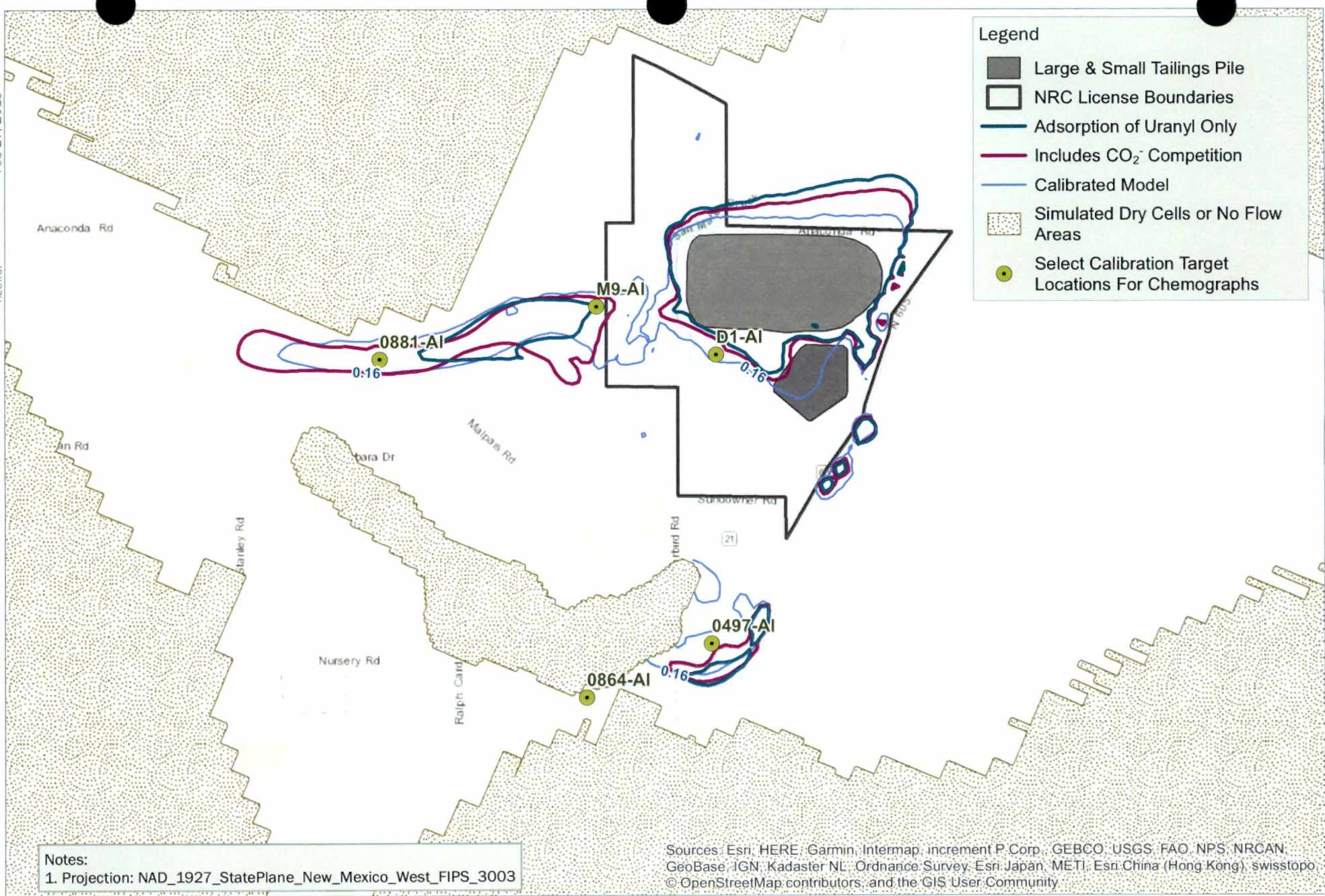
— Calibrated Model — Adsorption of Uranyl Only — Includes CO2- Competition



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Groundwater Fate and Transport Modeling
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Figure 6-2
Freundlich Sensitivity Parameter Retardation
Factor Comparison

[BCDENFP01]; P:\Data\GEN\Barrick Homestake Model\GIS_SiteModelReporting\Figure6-3_2017SiteAL_UContours_Freundlich.mxd
Feb 27, 2019
kzeiler



Homestake Mining Company
Grants Reclamation Project
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Transport Modeling
Date: March 2019
Project: 152816

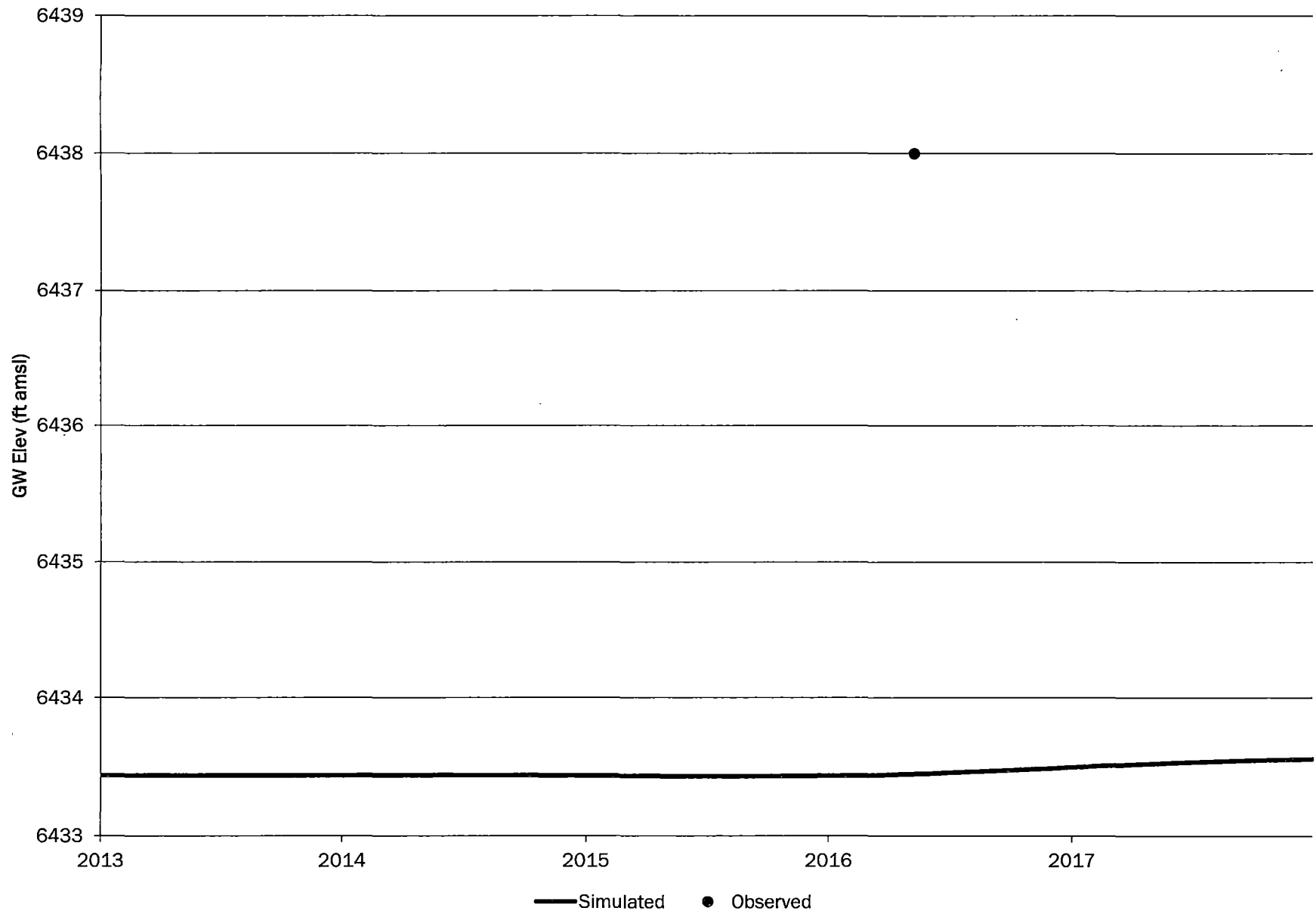


Figure 6-3
Freundlich Parameter Sensitivity
2017 Alluvial Aquifer Uranium
0.16 mg/L Concentration Contours

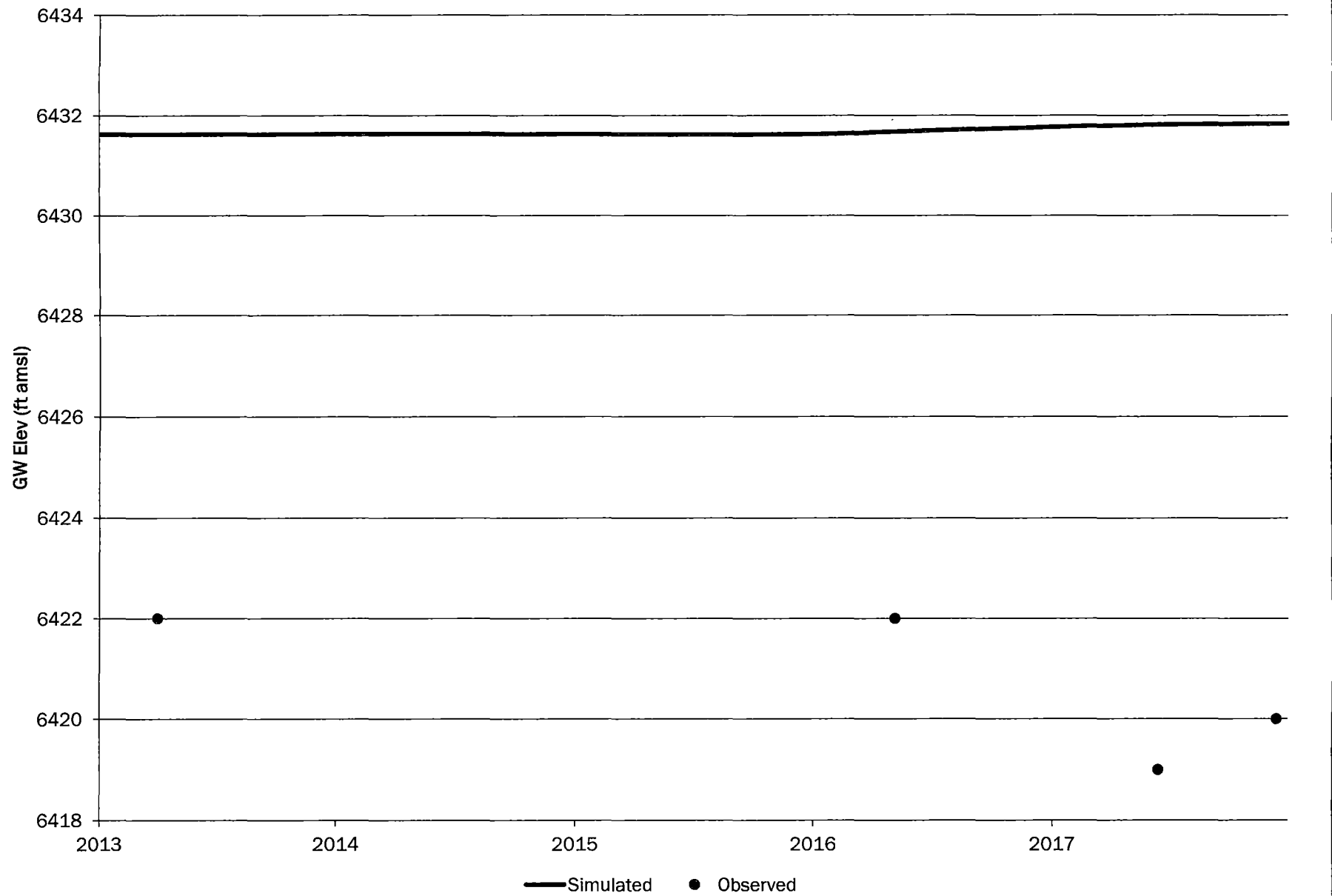
Appendix A: Simulated Groundwater Hydrographs

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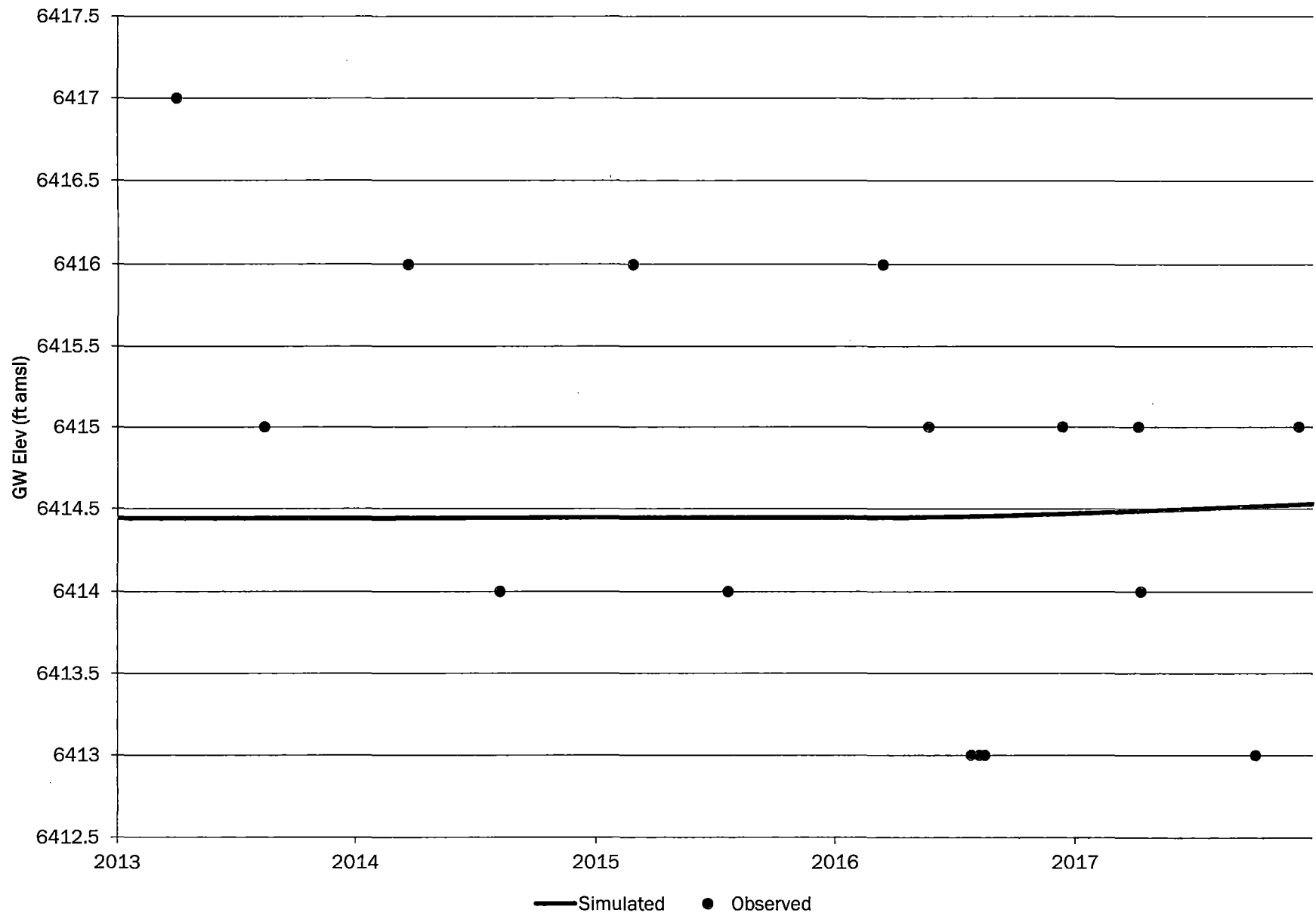
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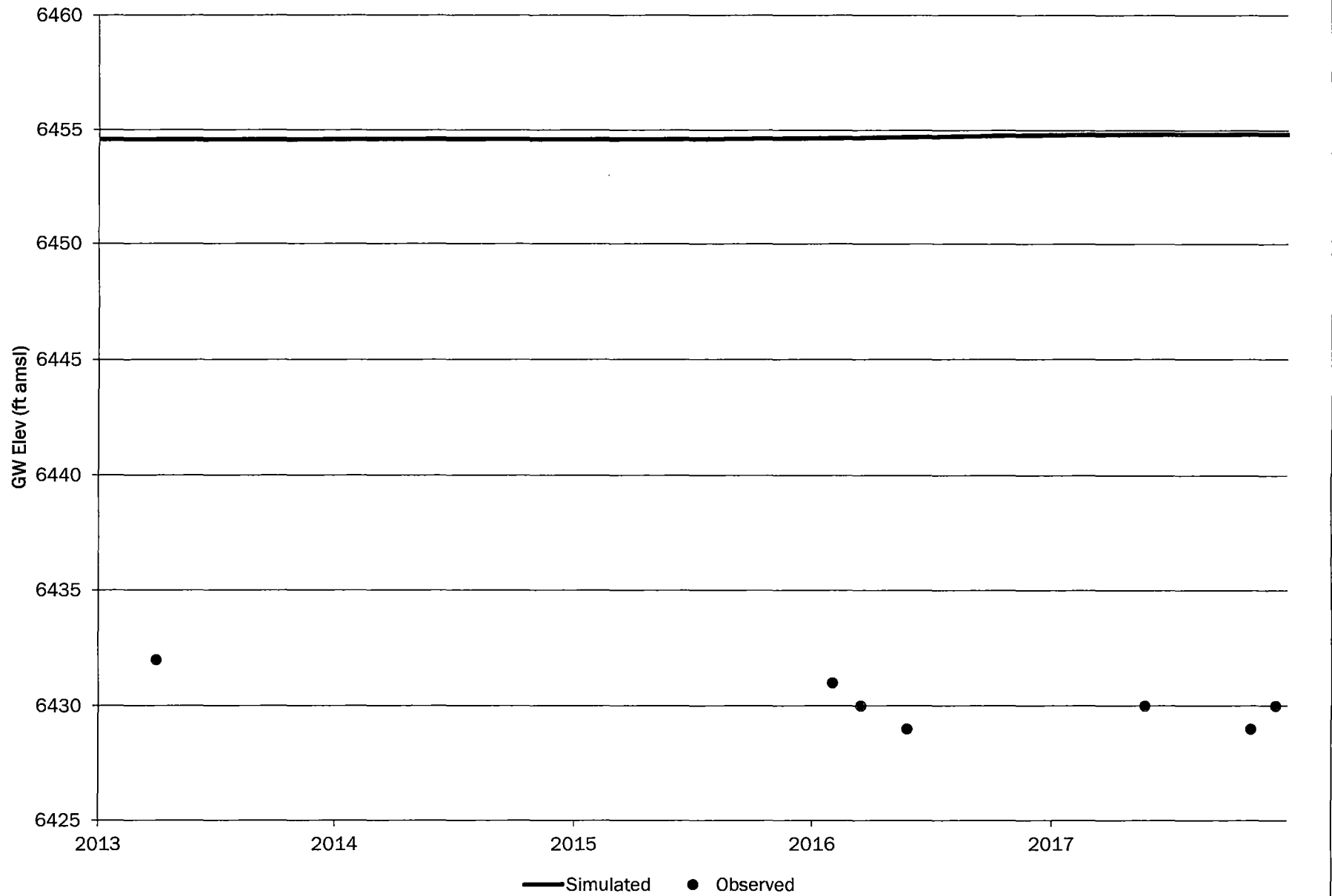
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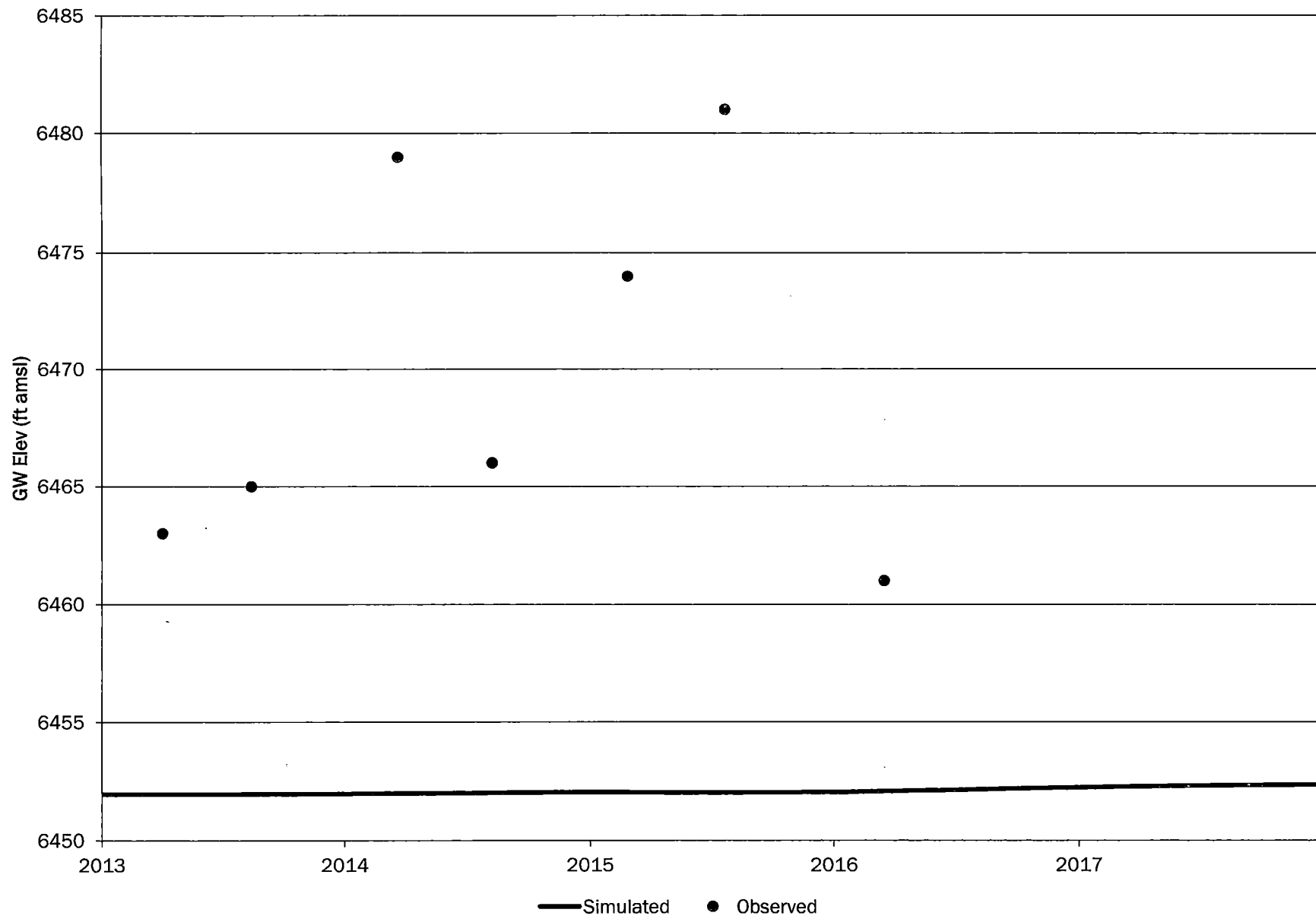
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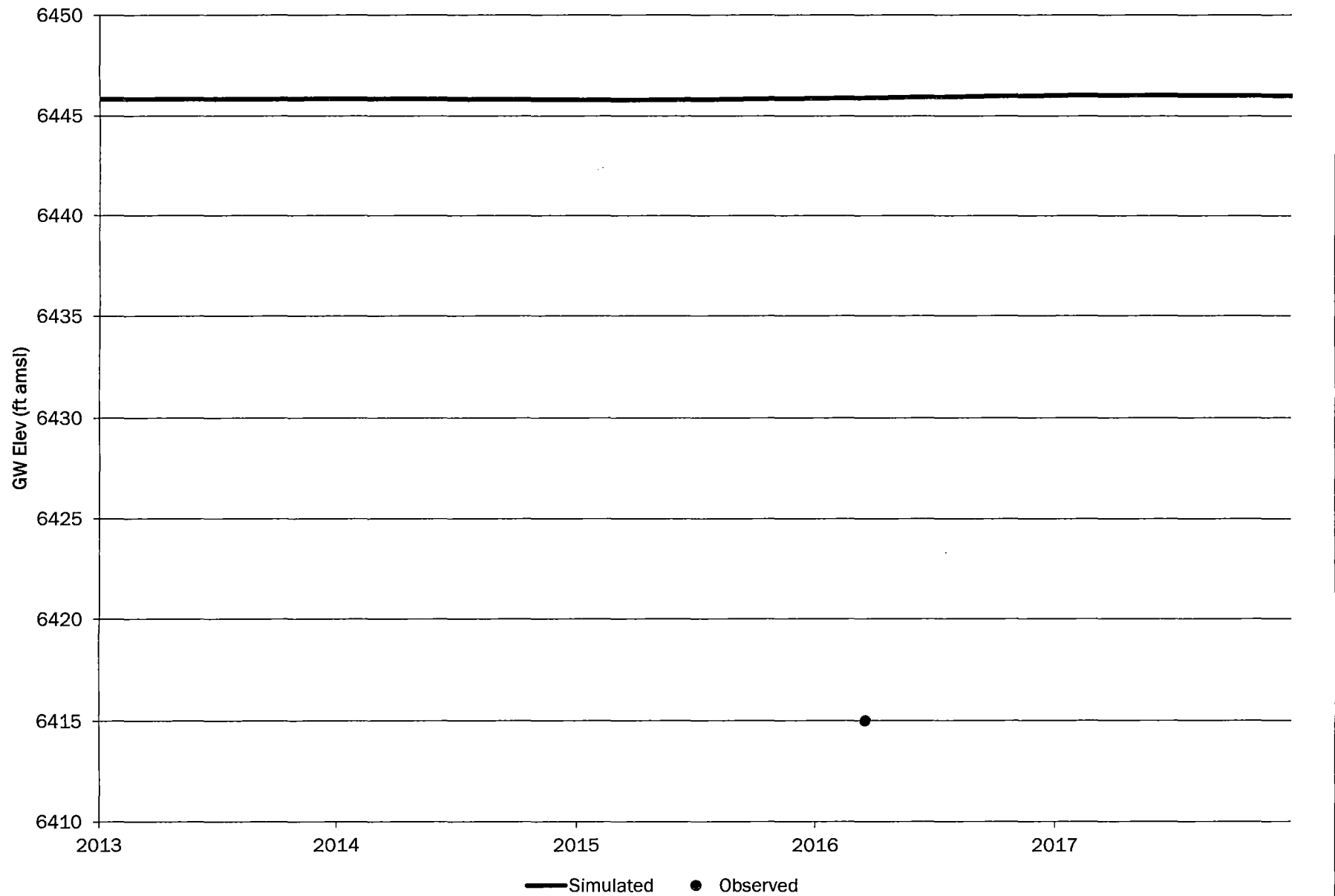
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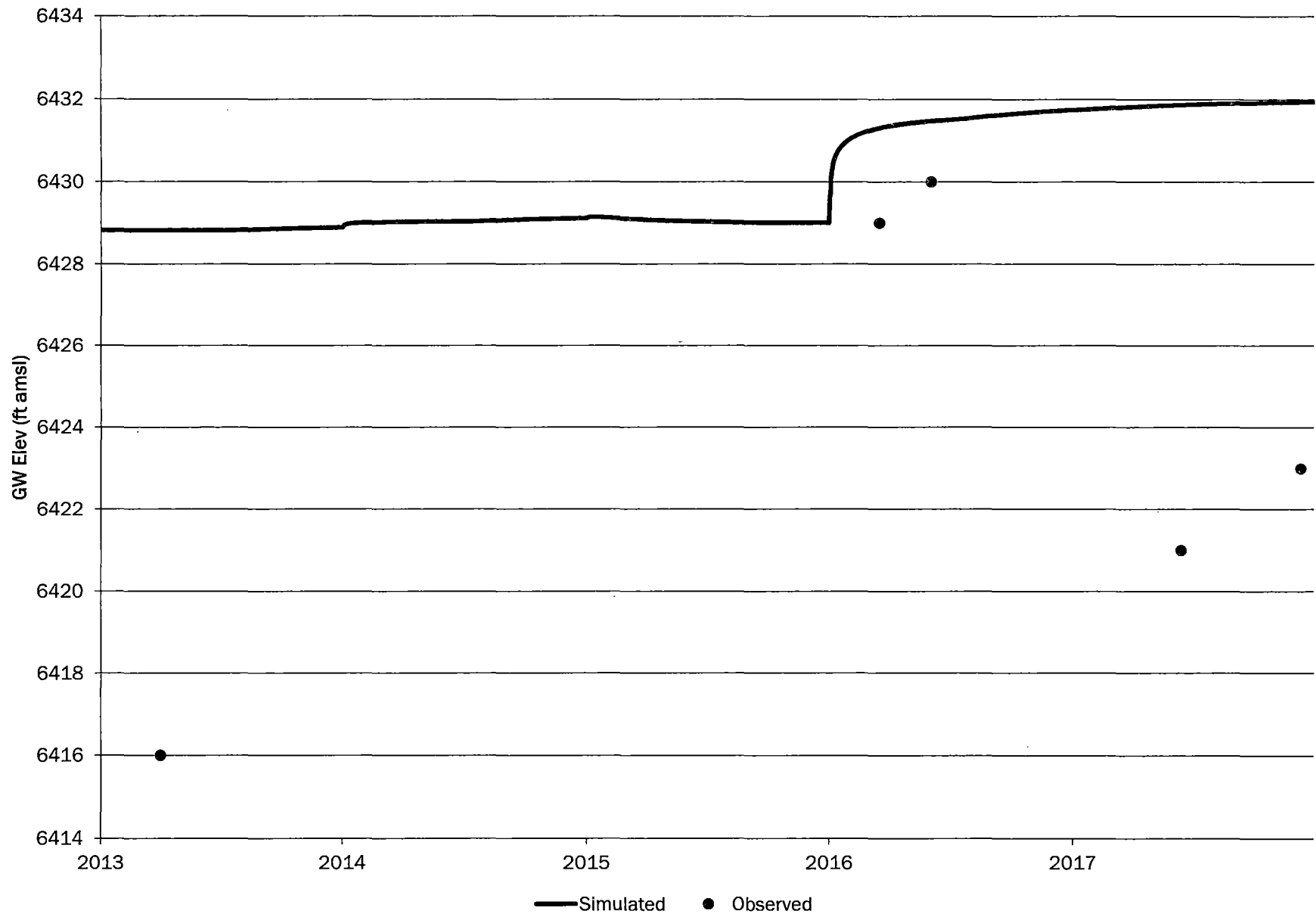
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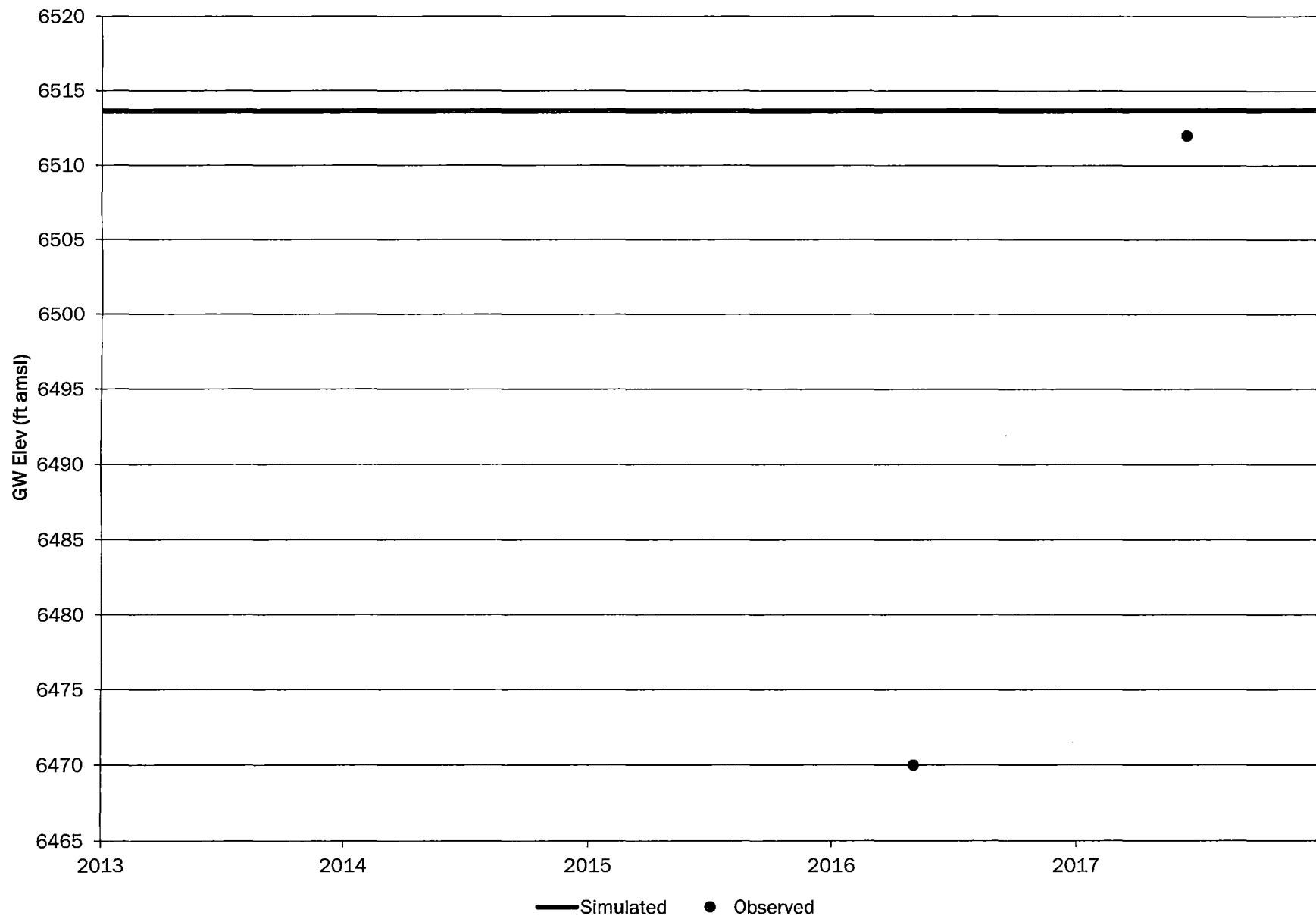
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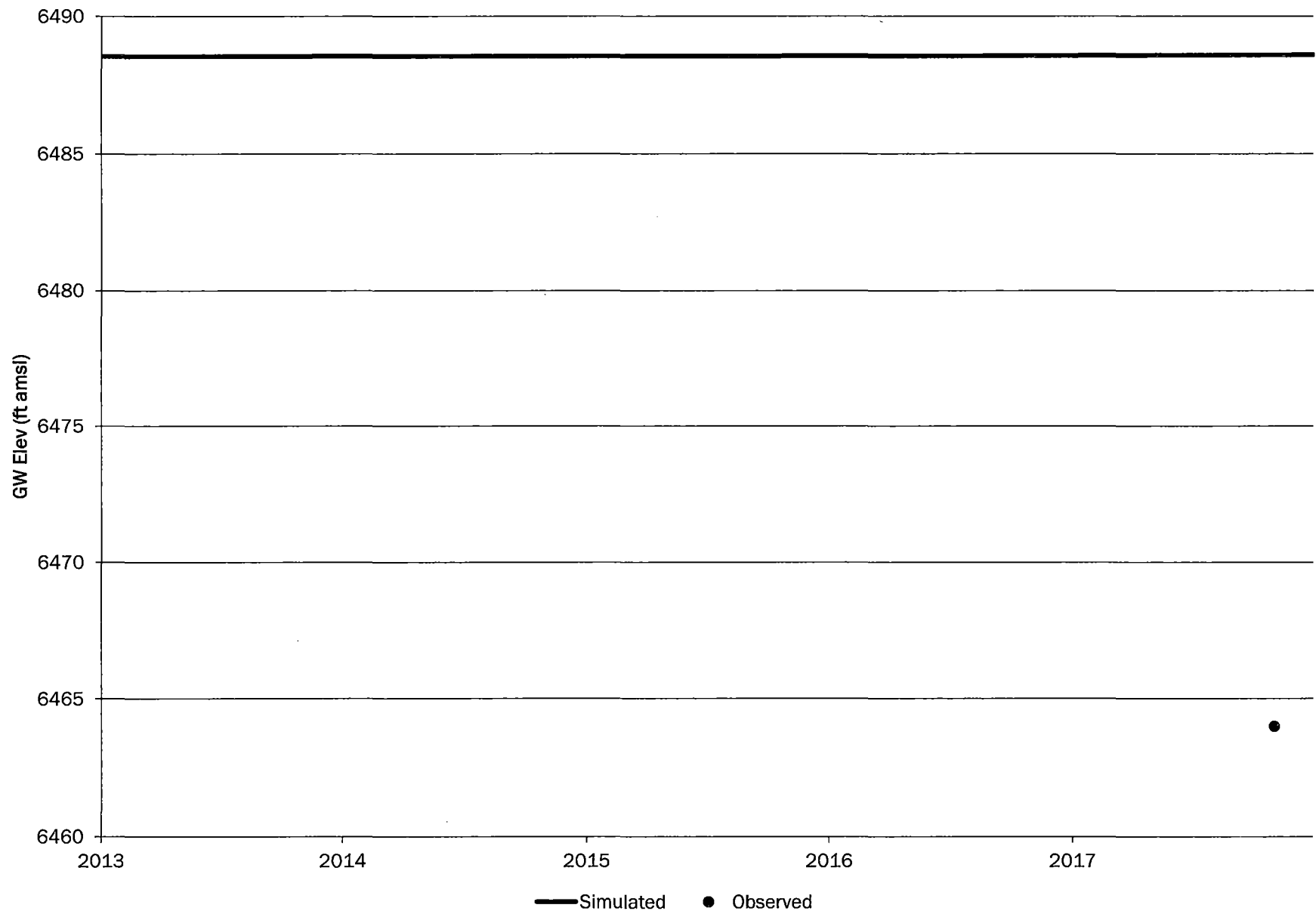
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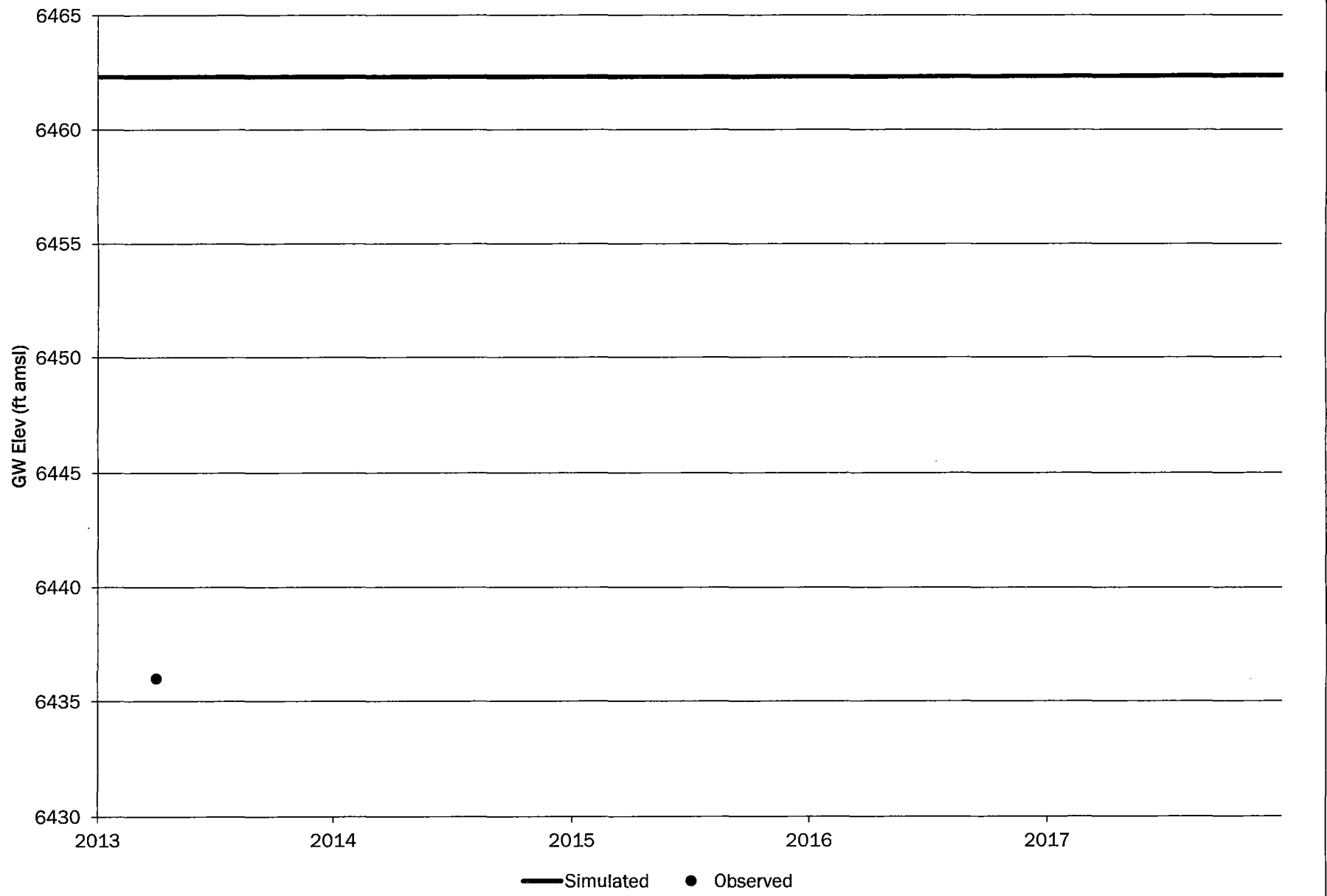
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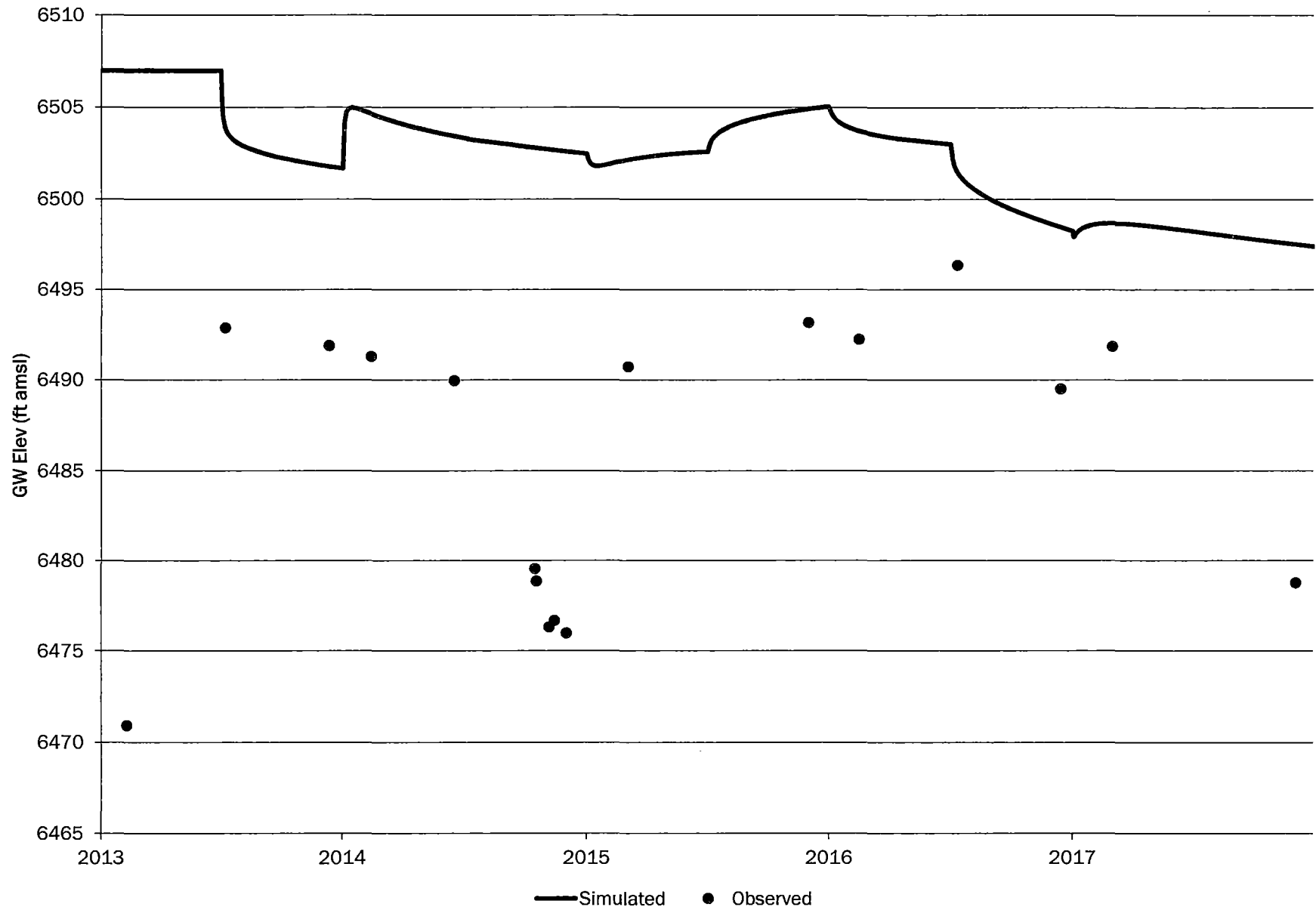
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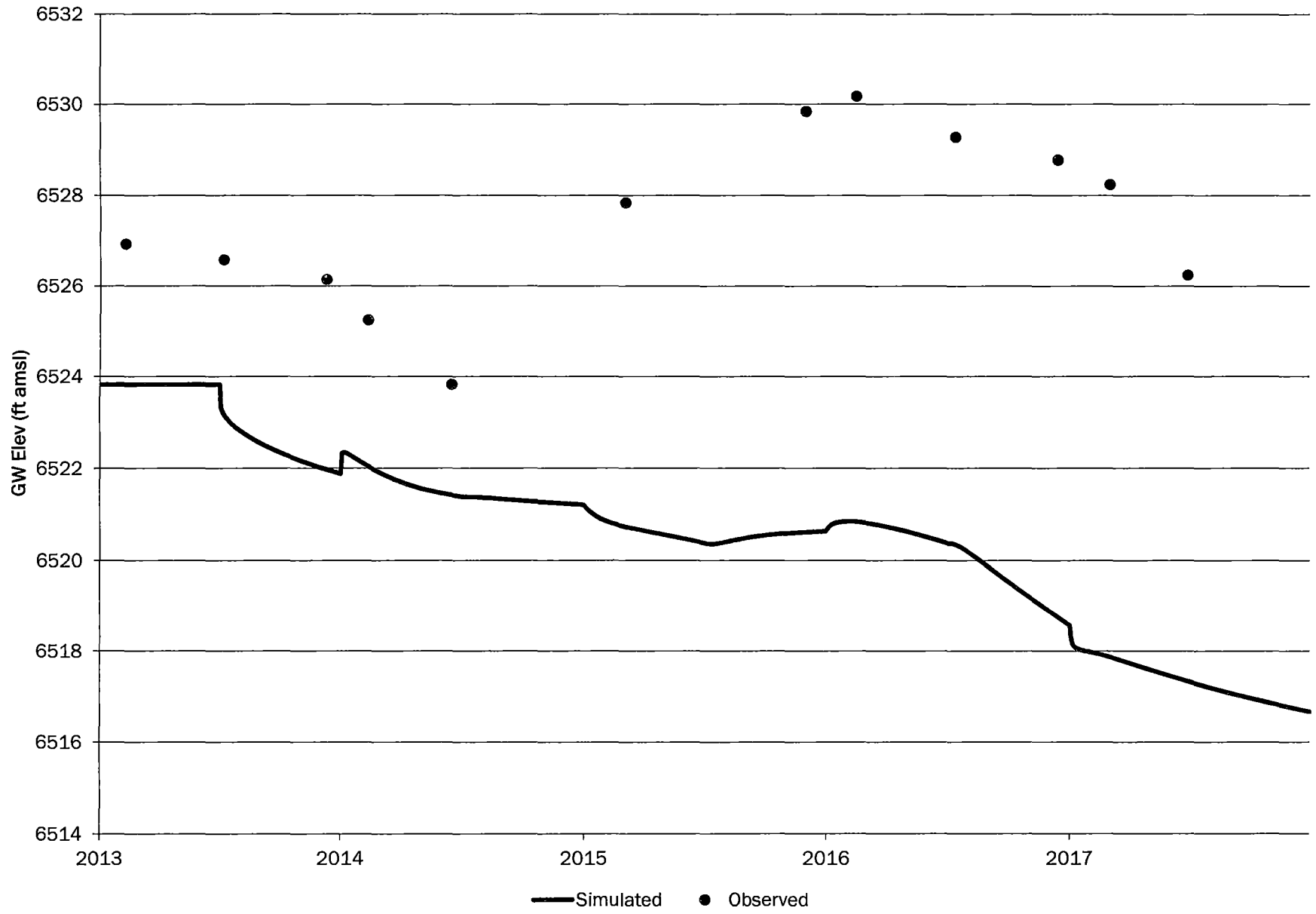
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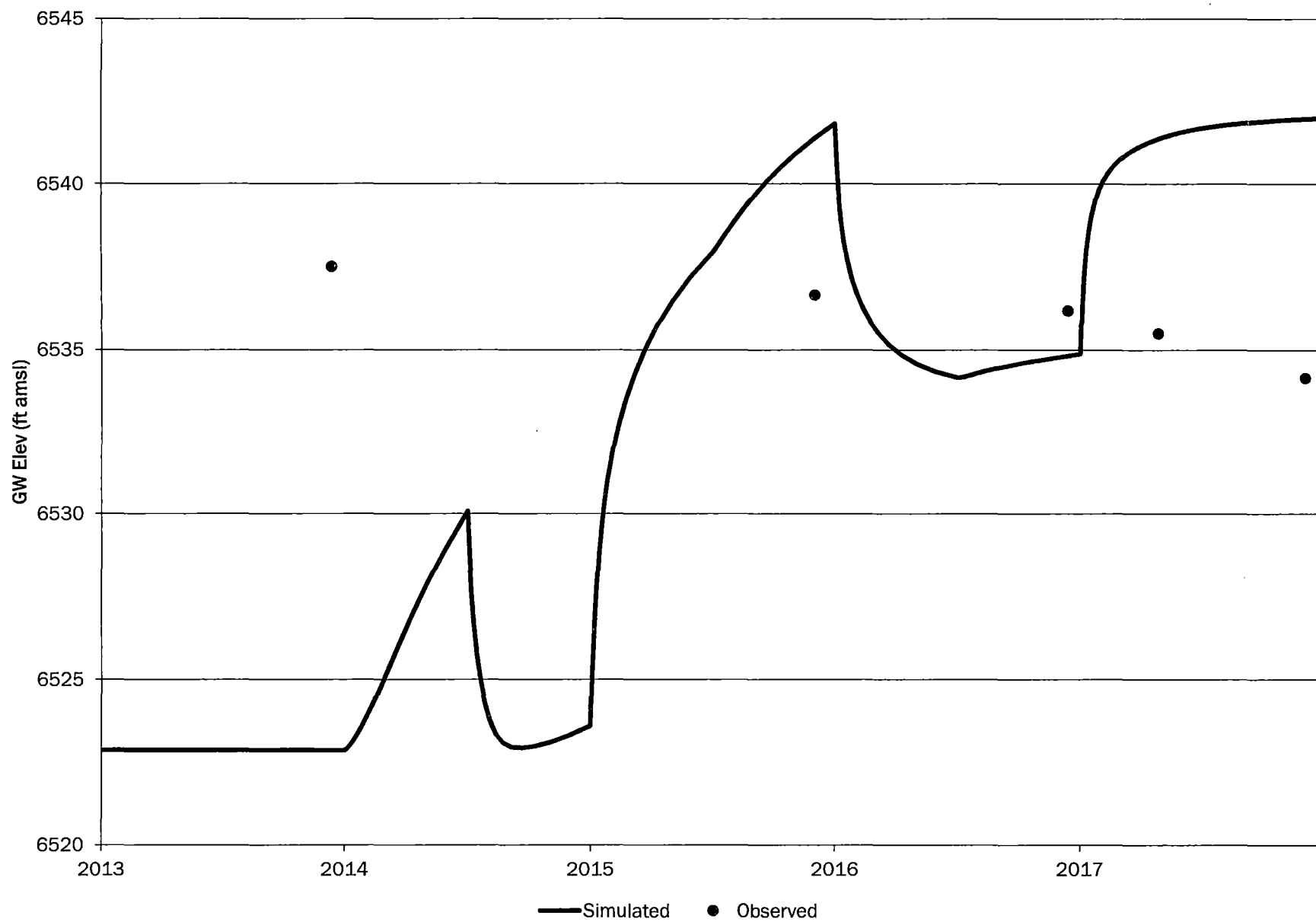
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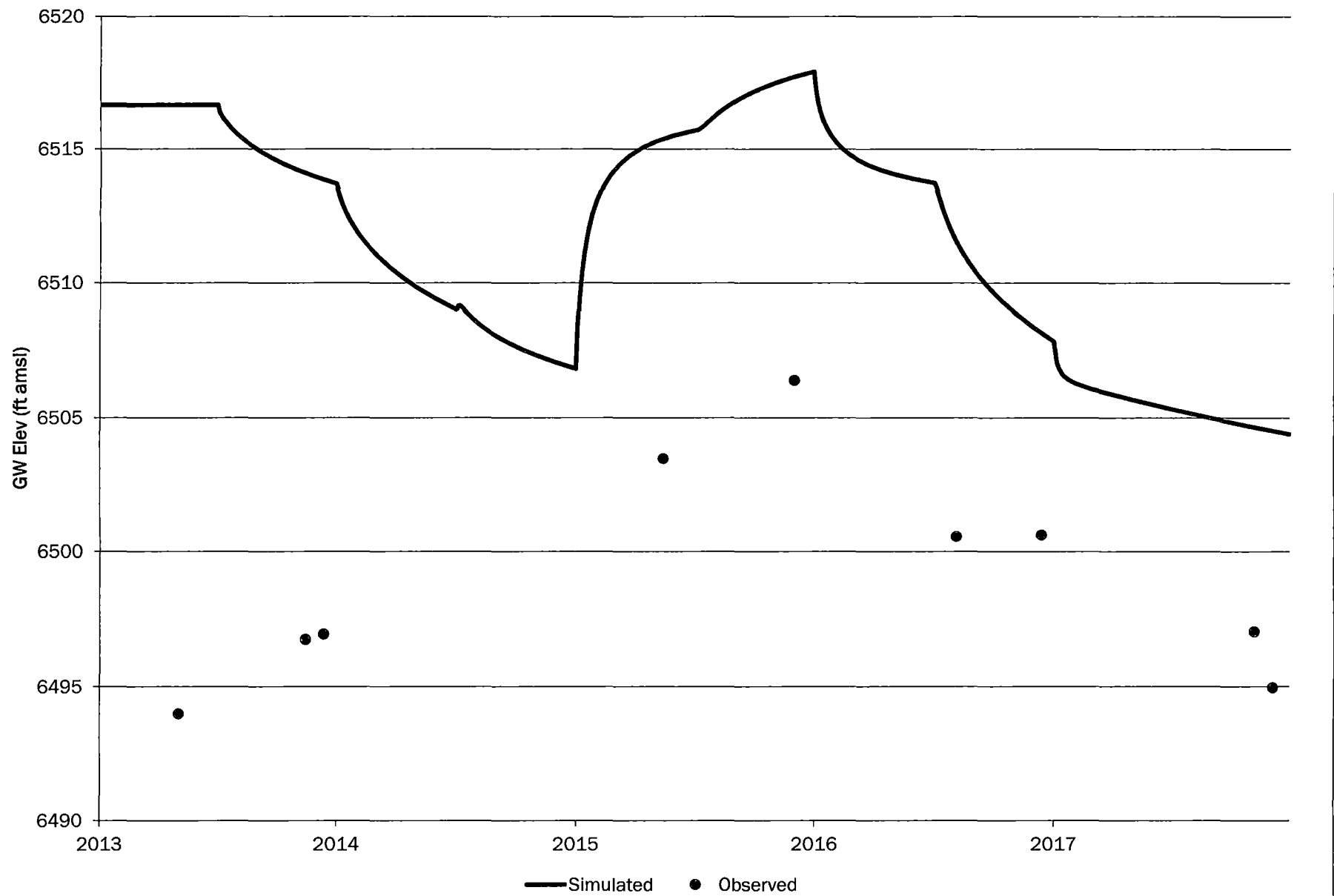
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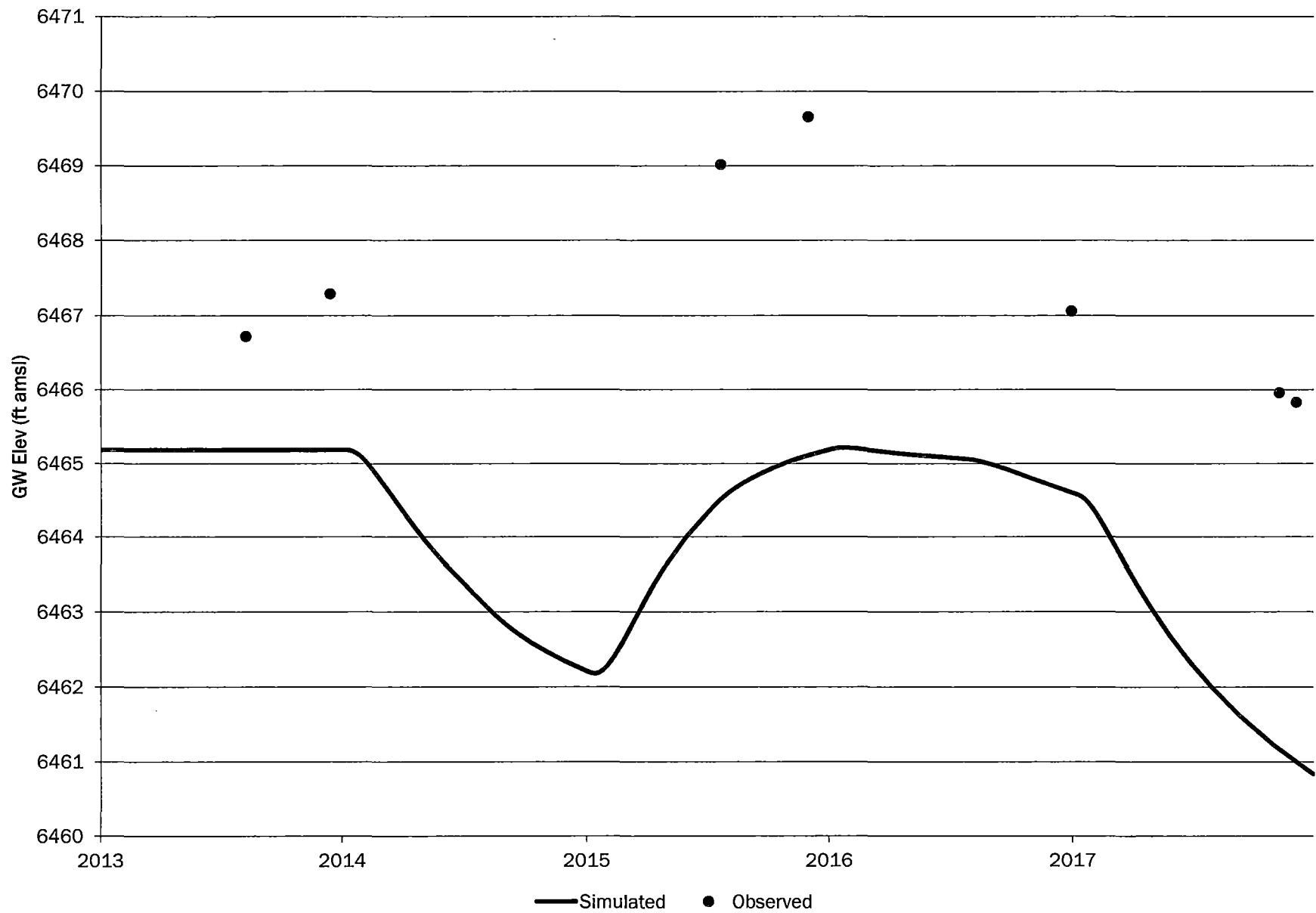
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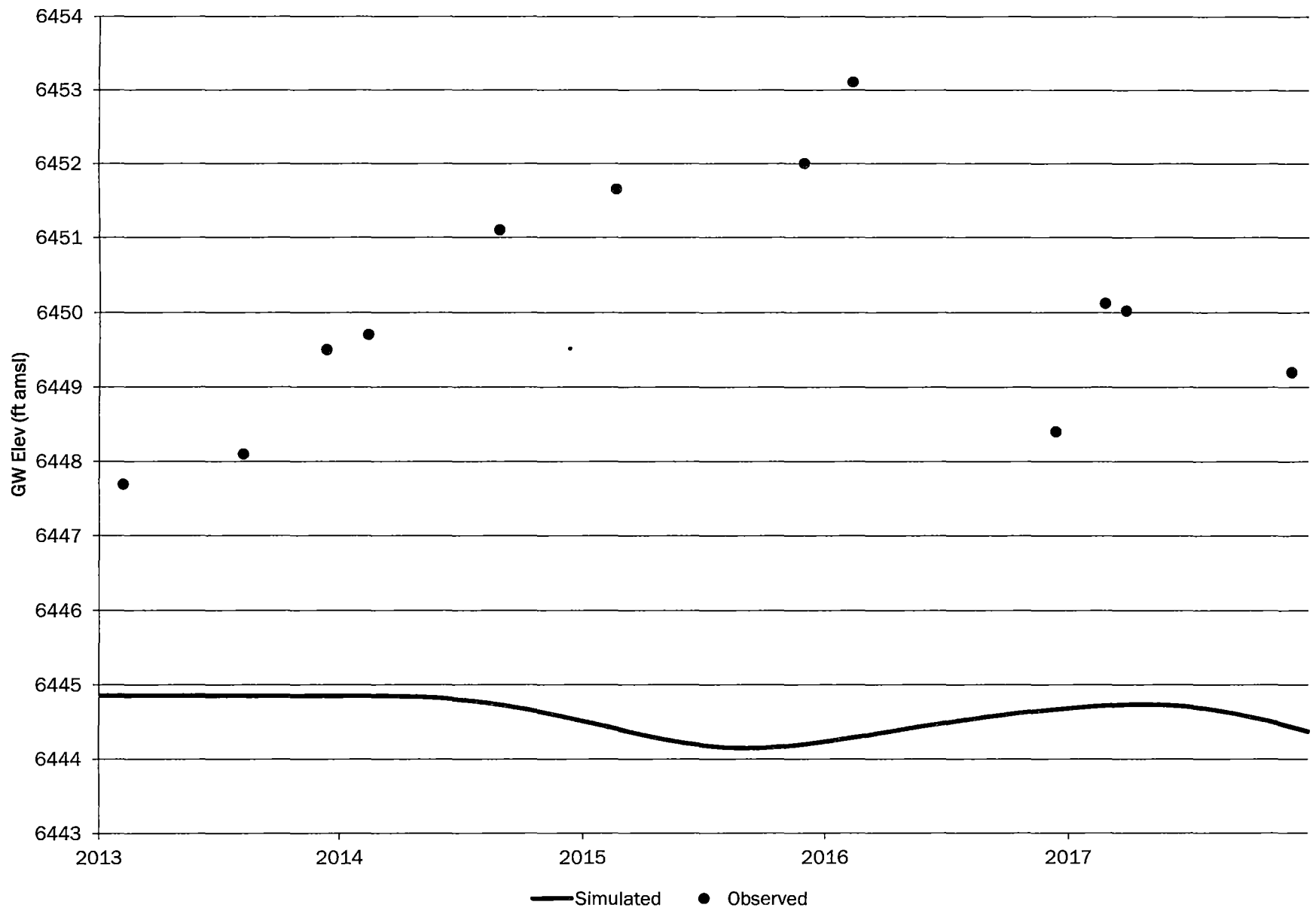
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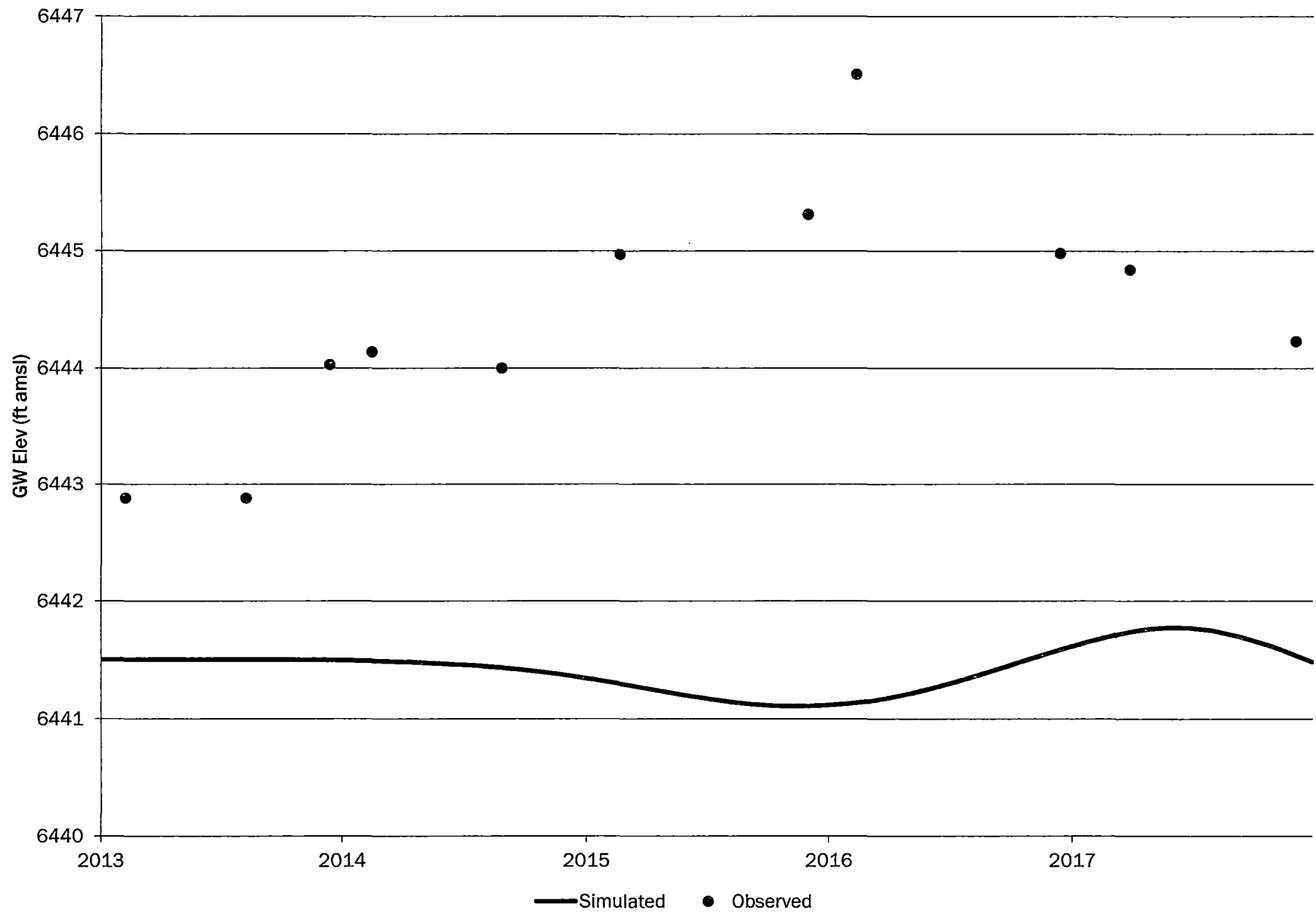
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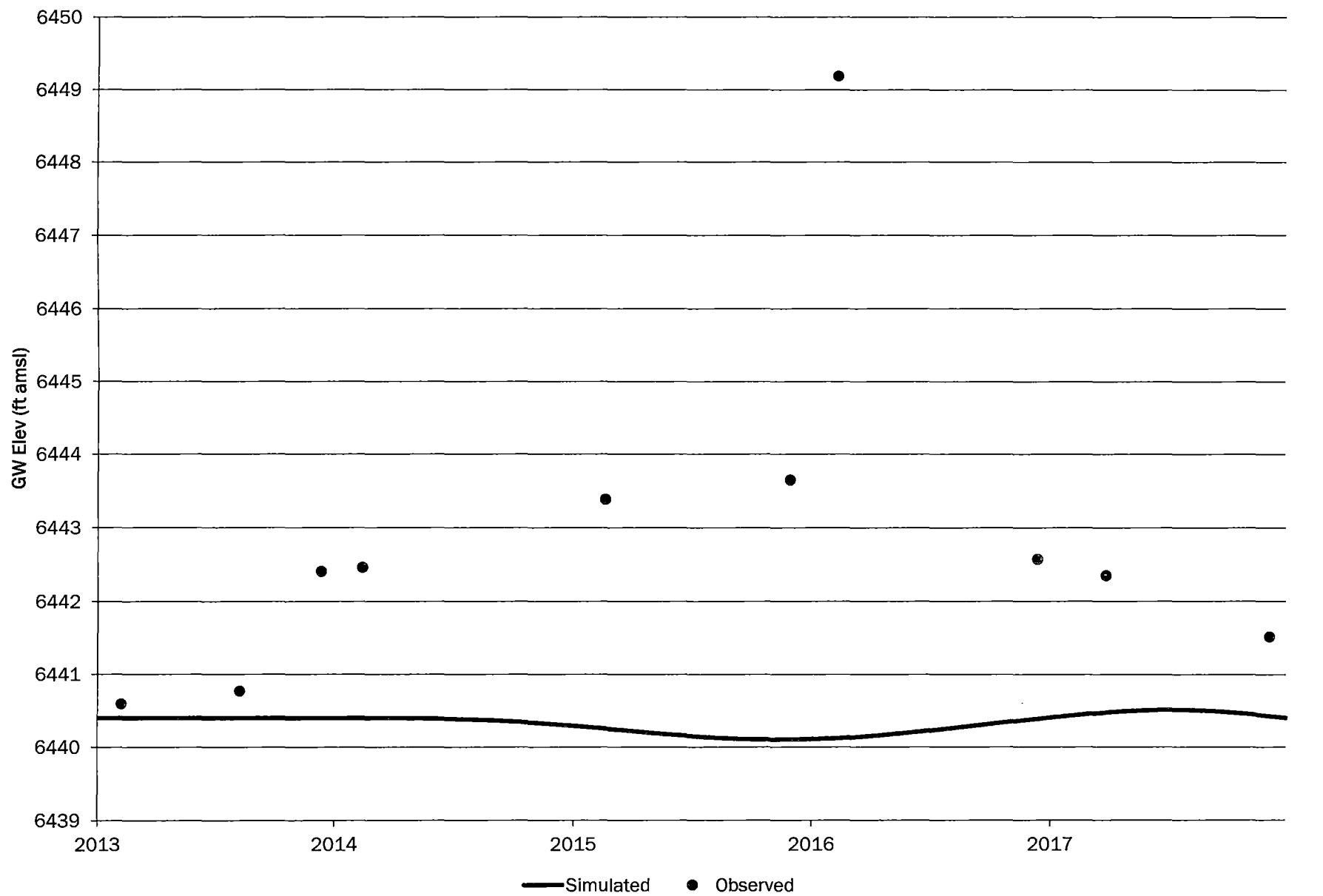
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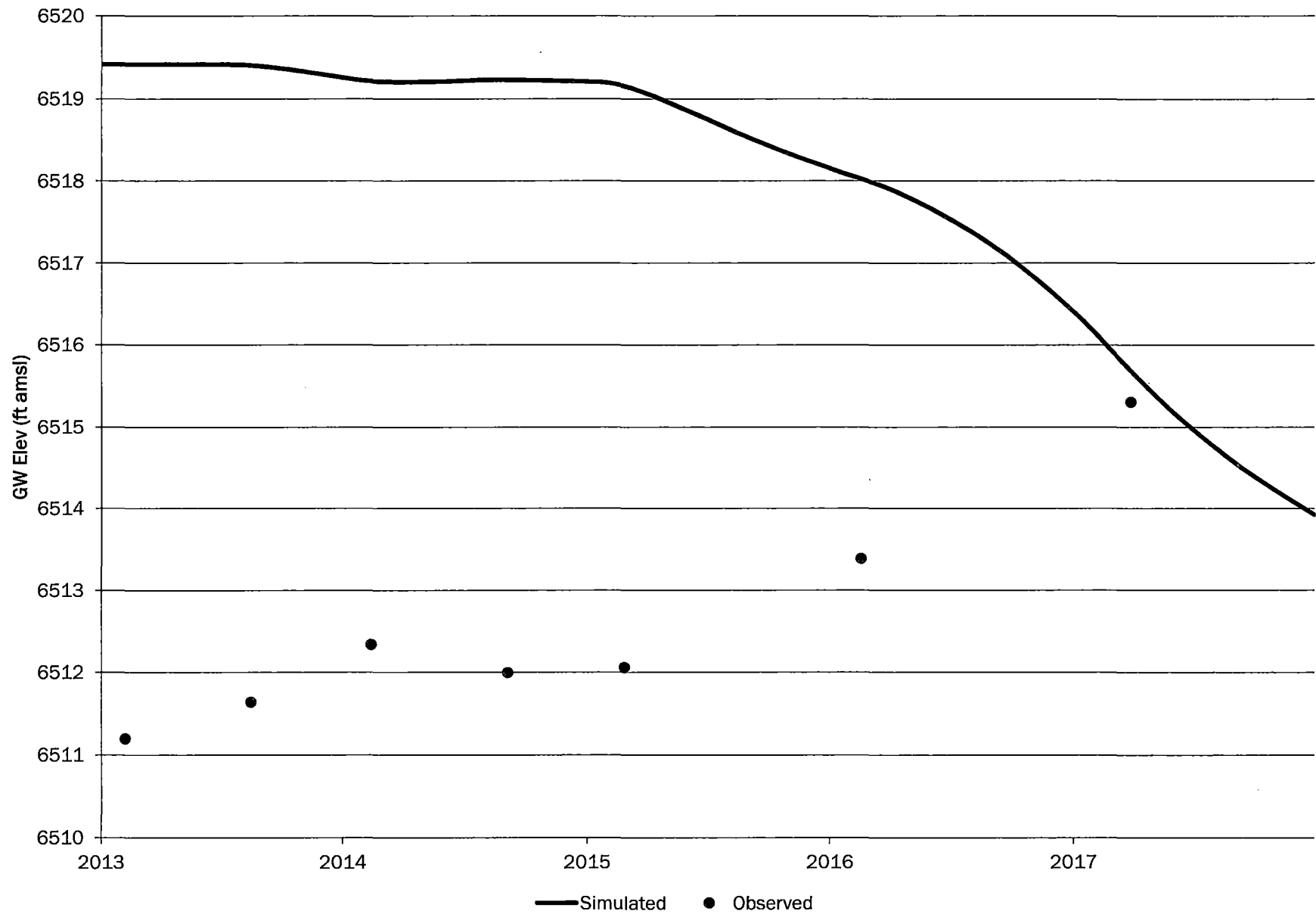
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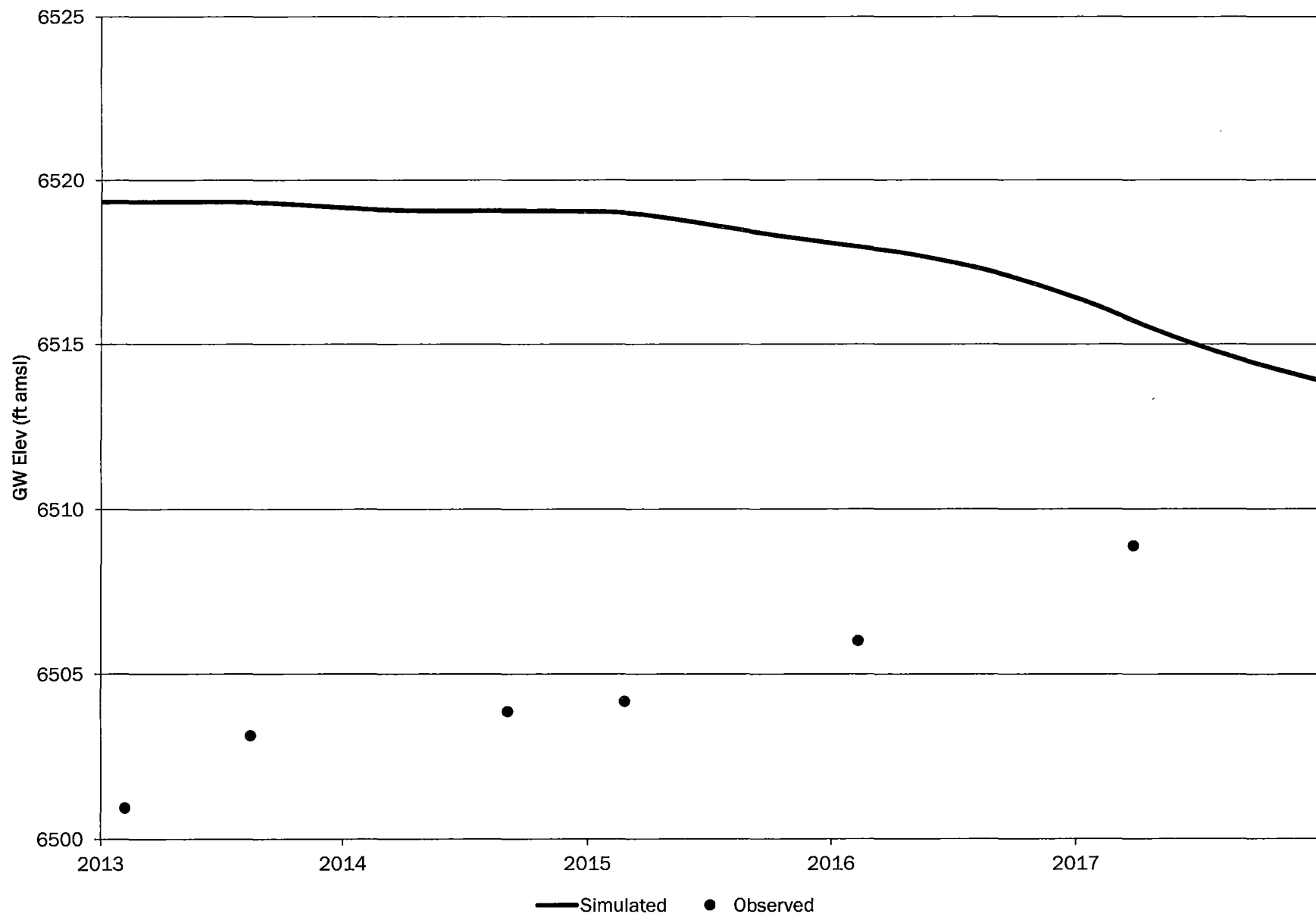
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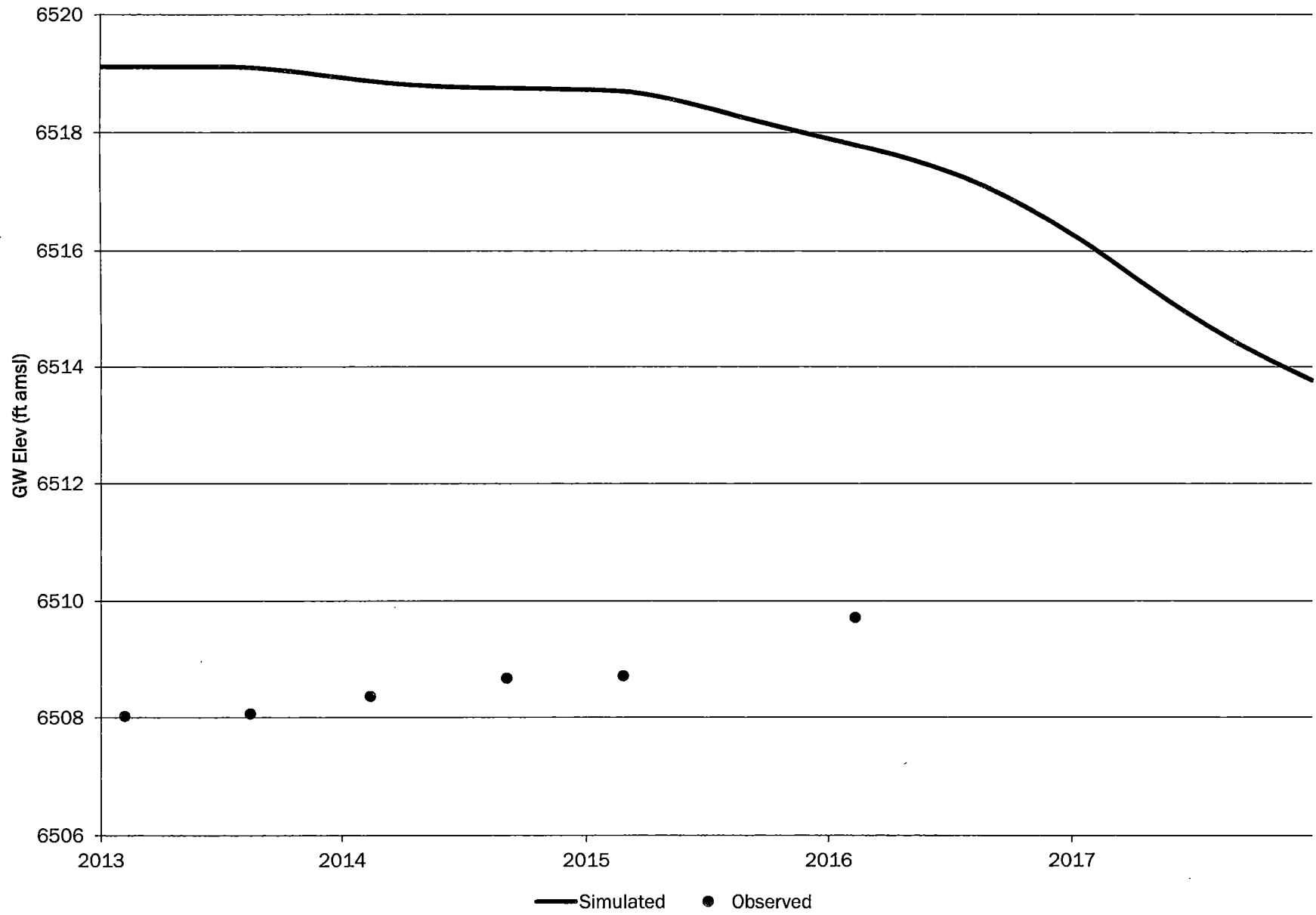
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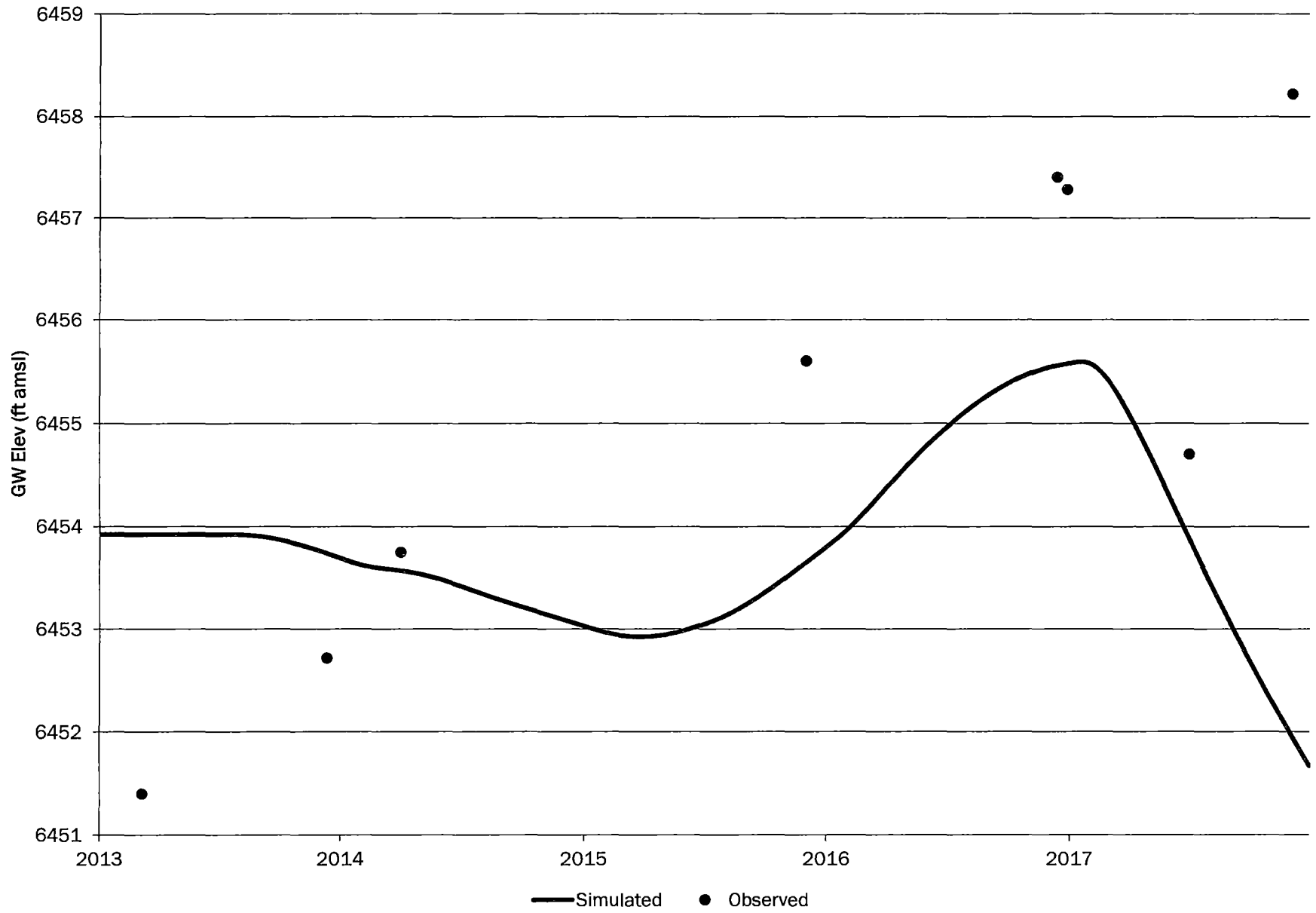
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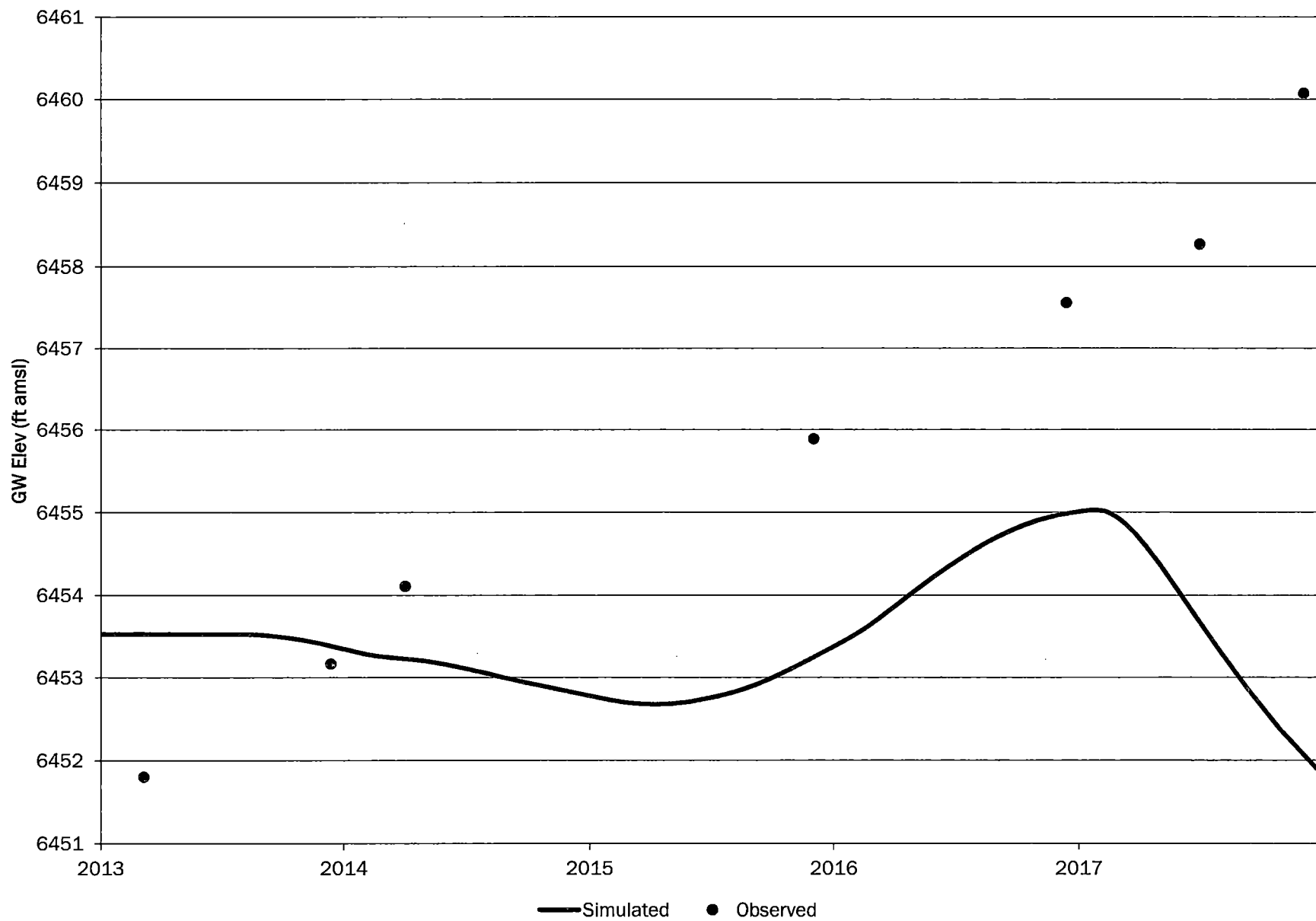
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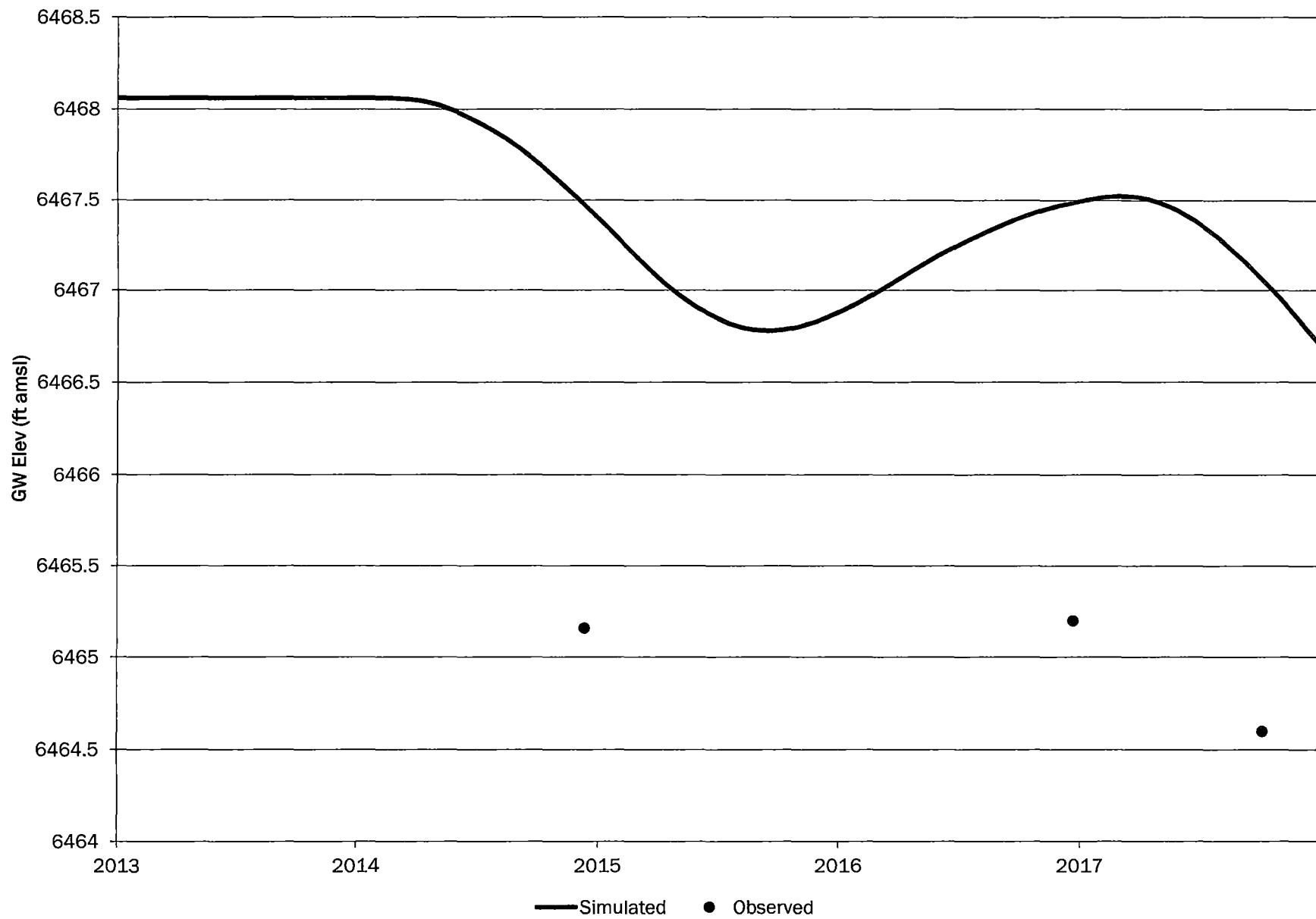
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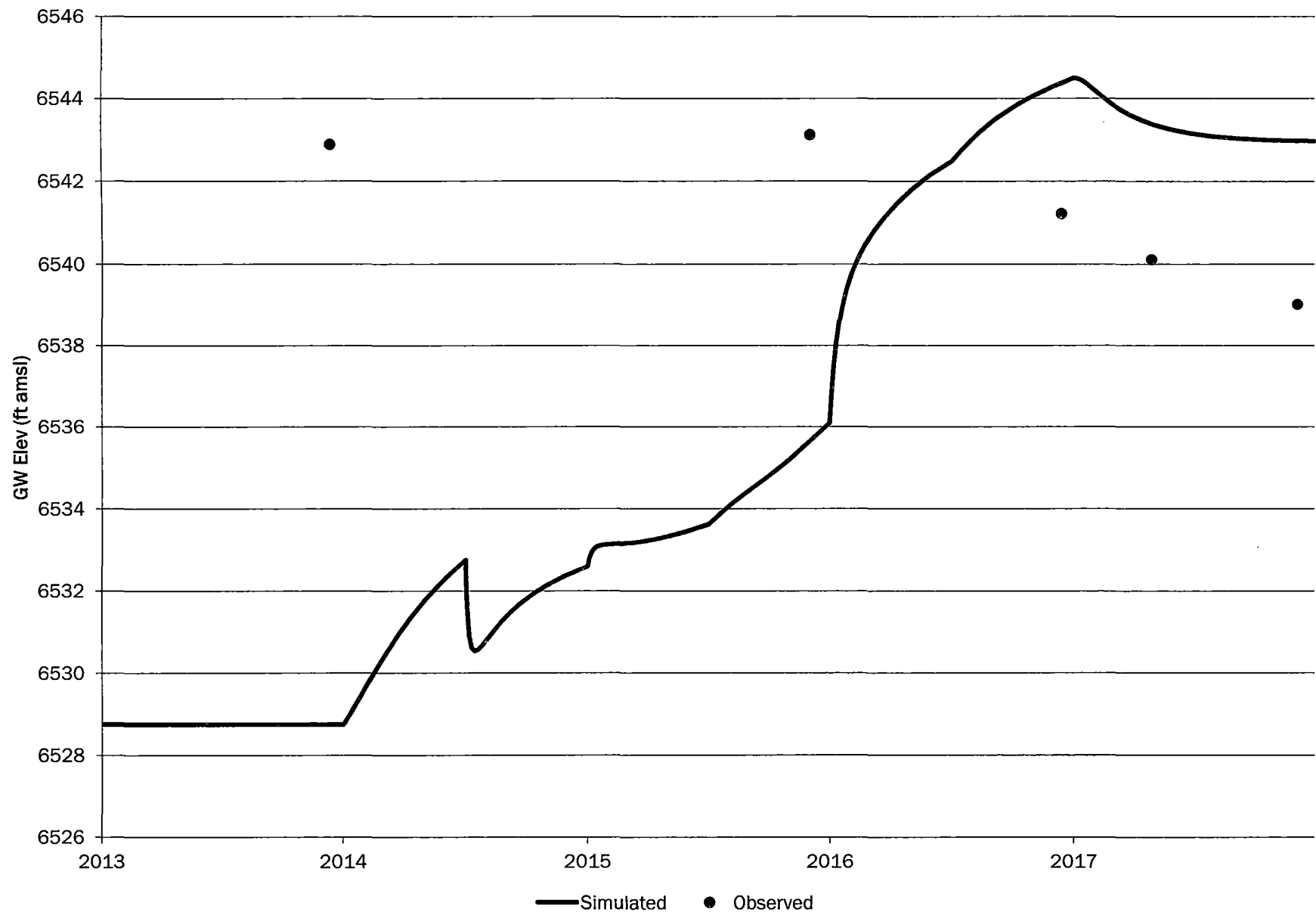
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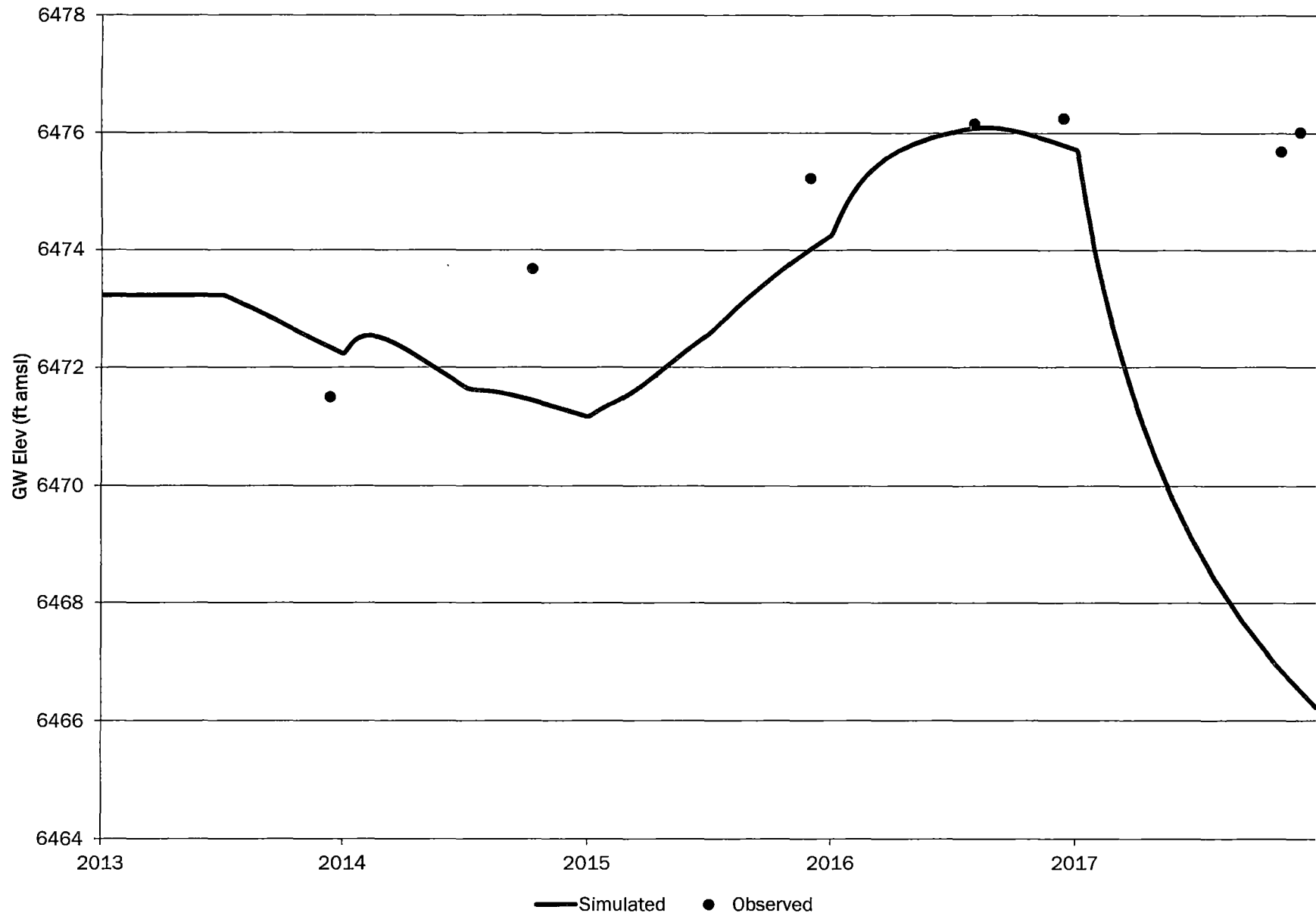
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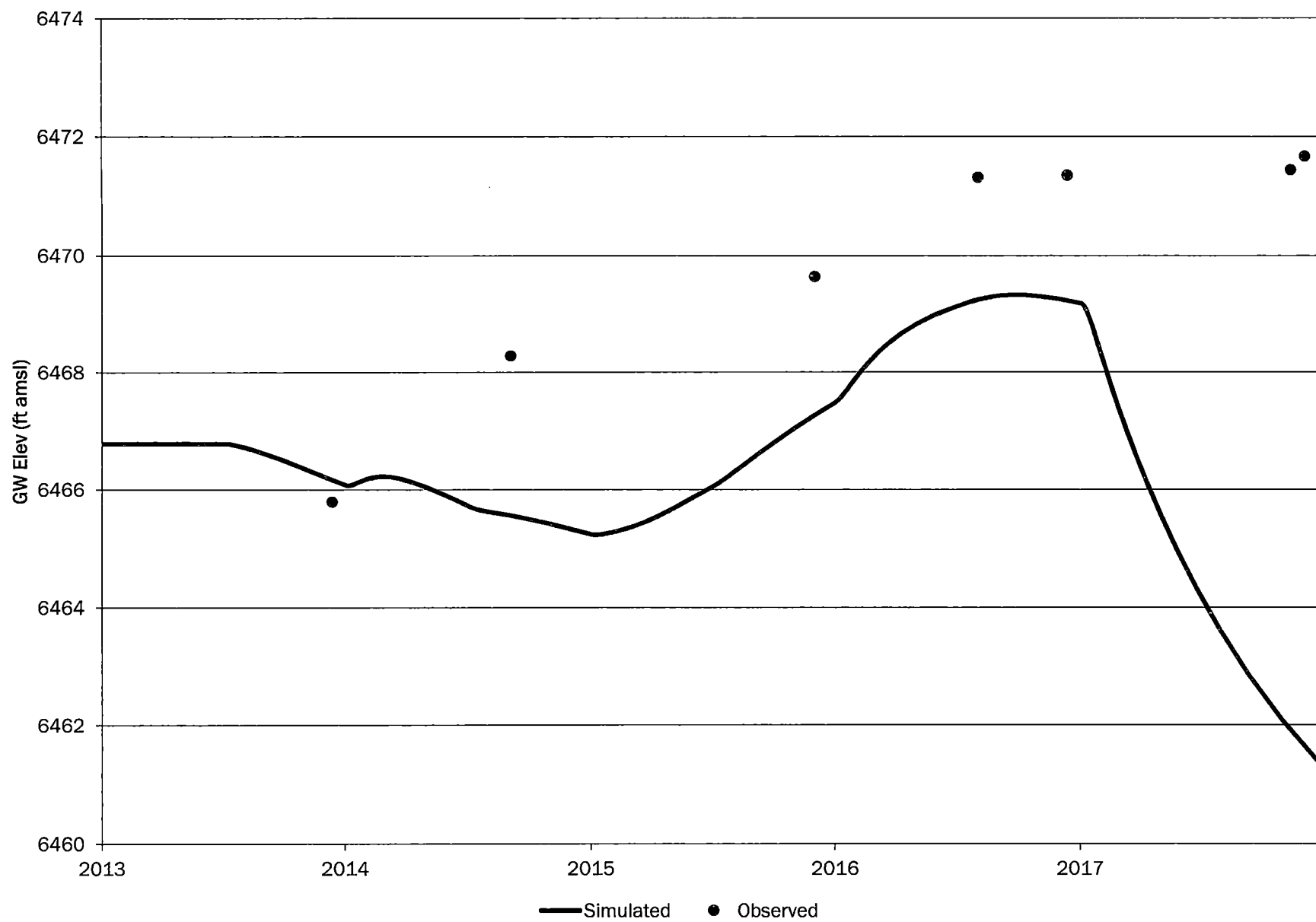
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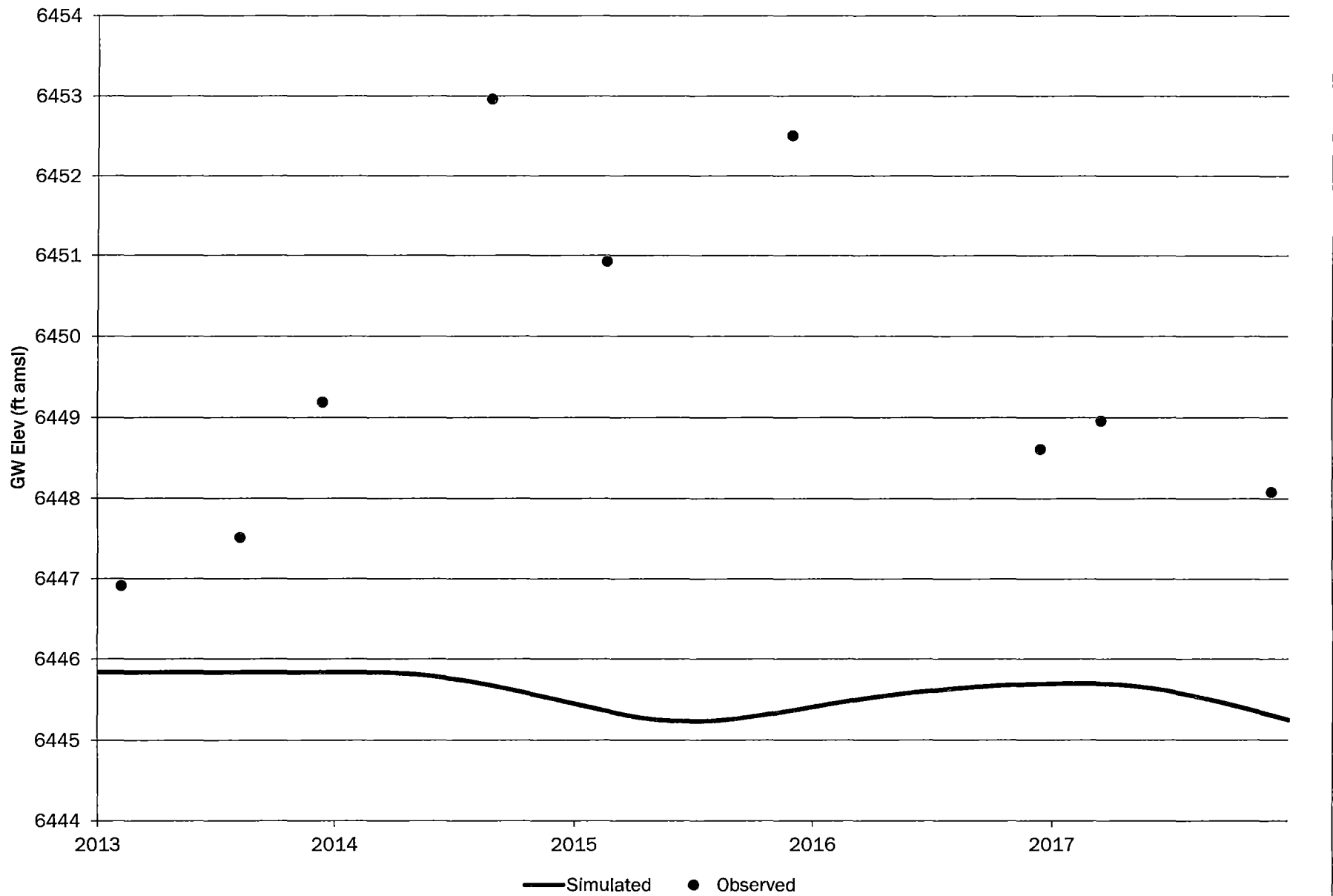
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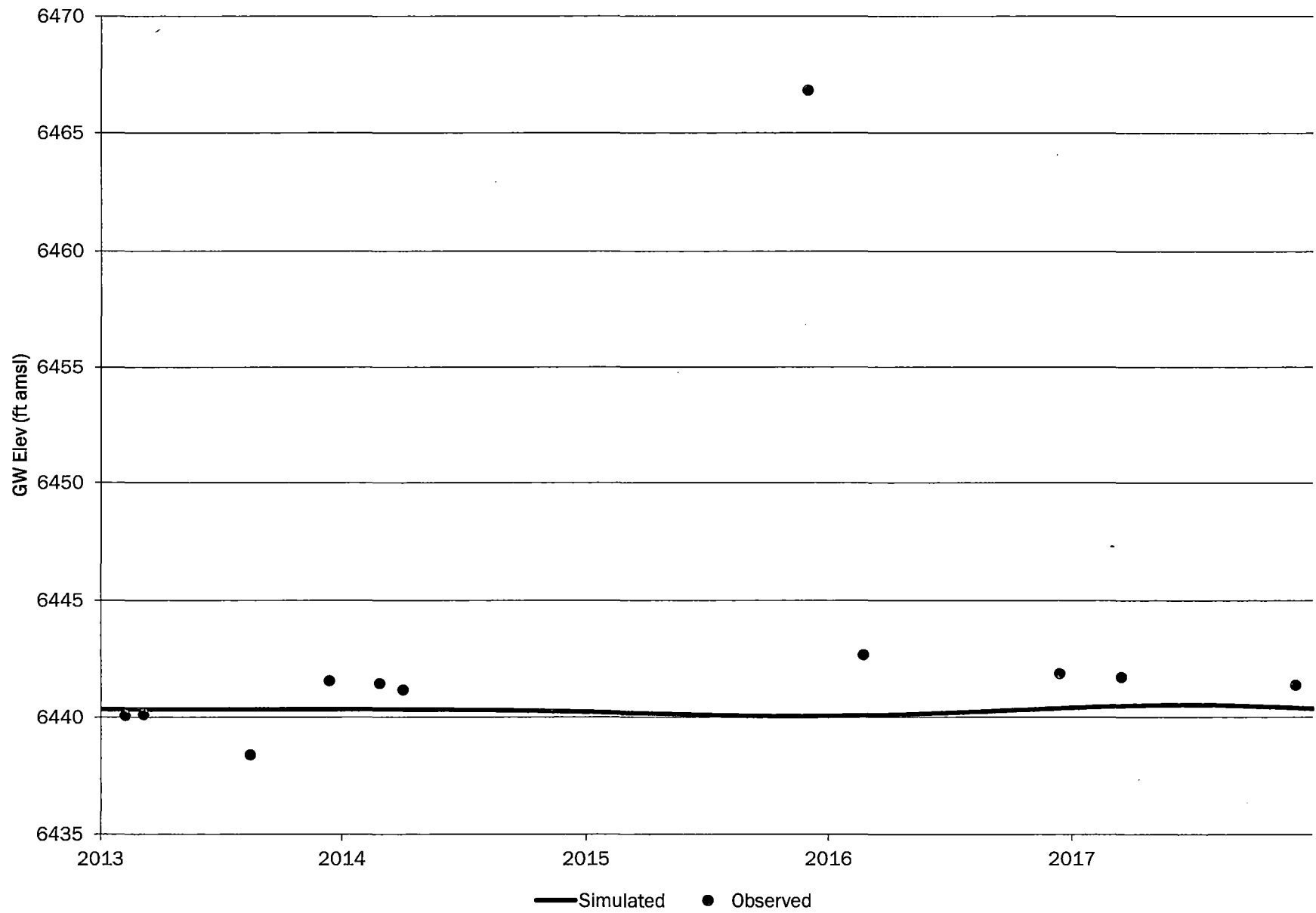
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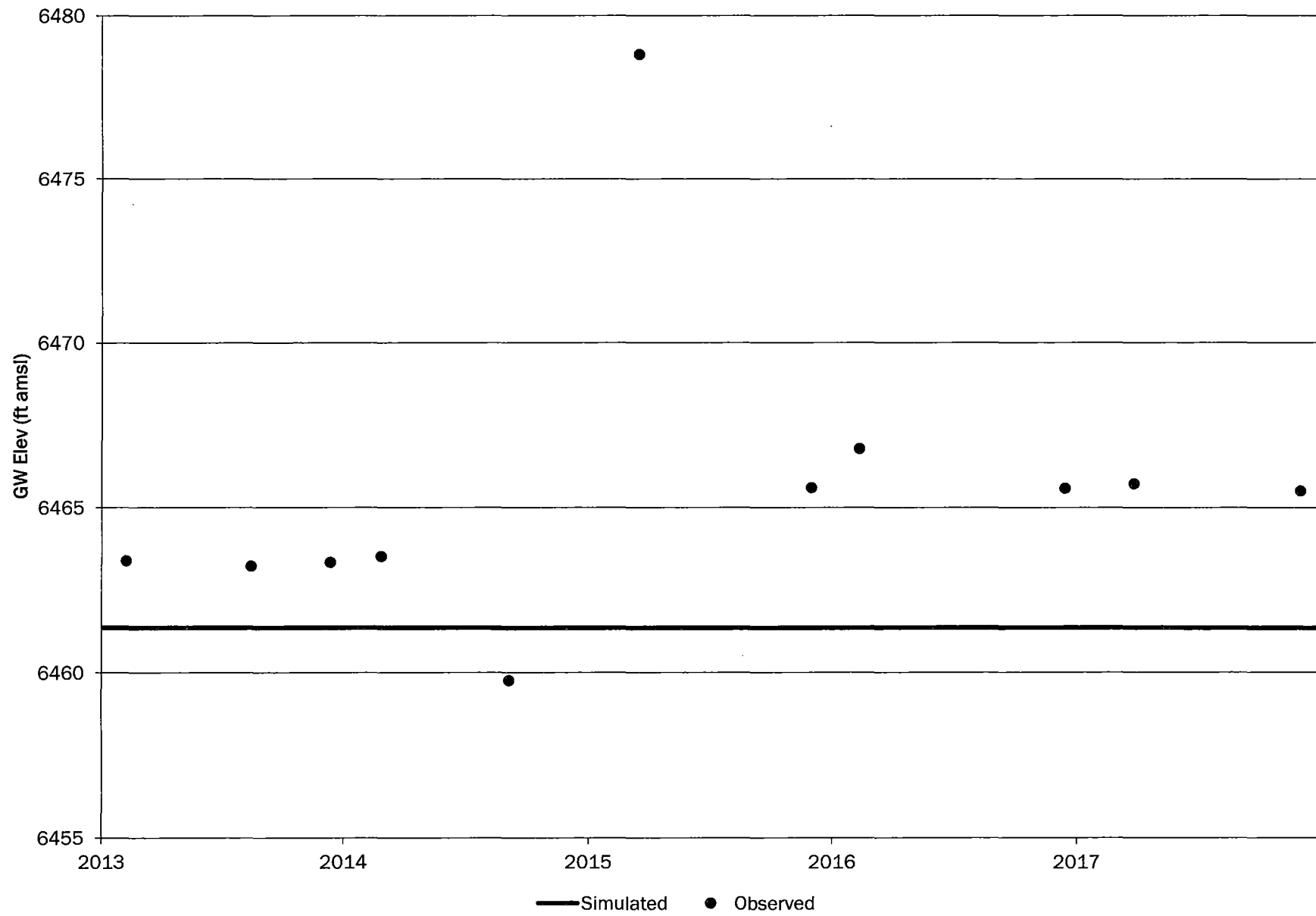
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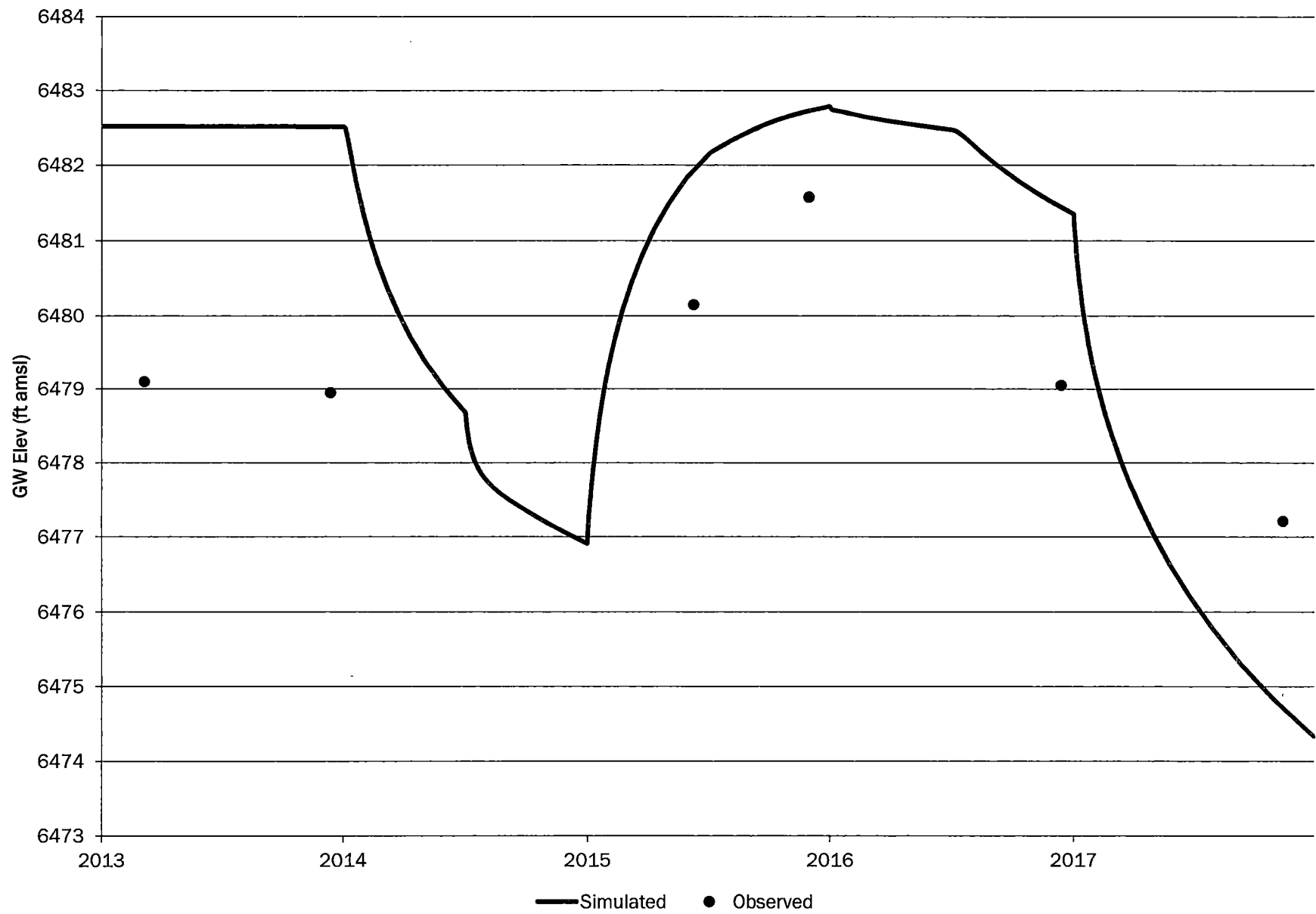
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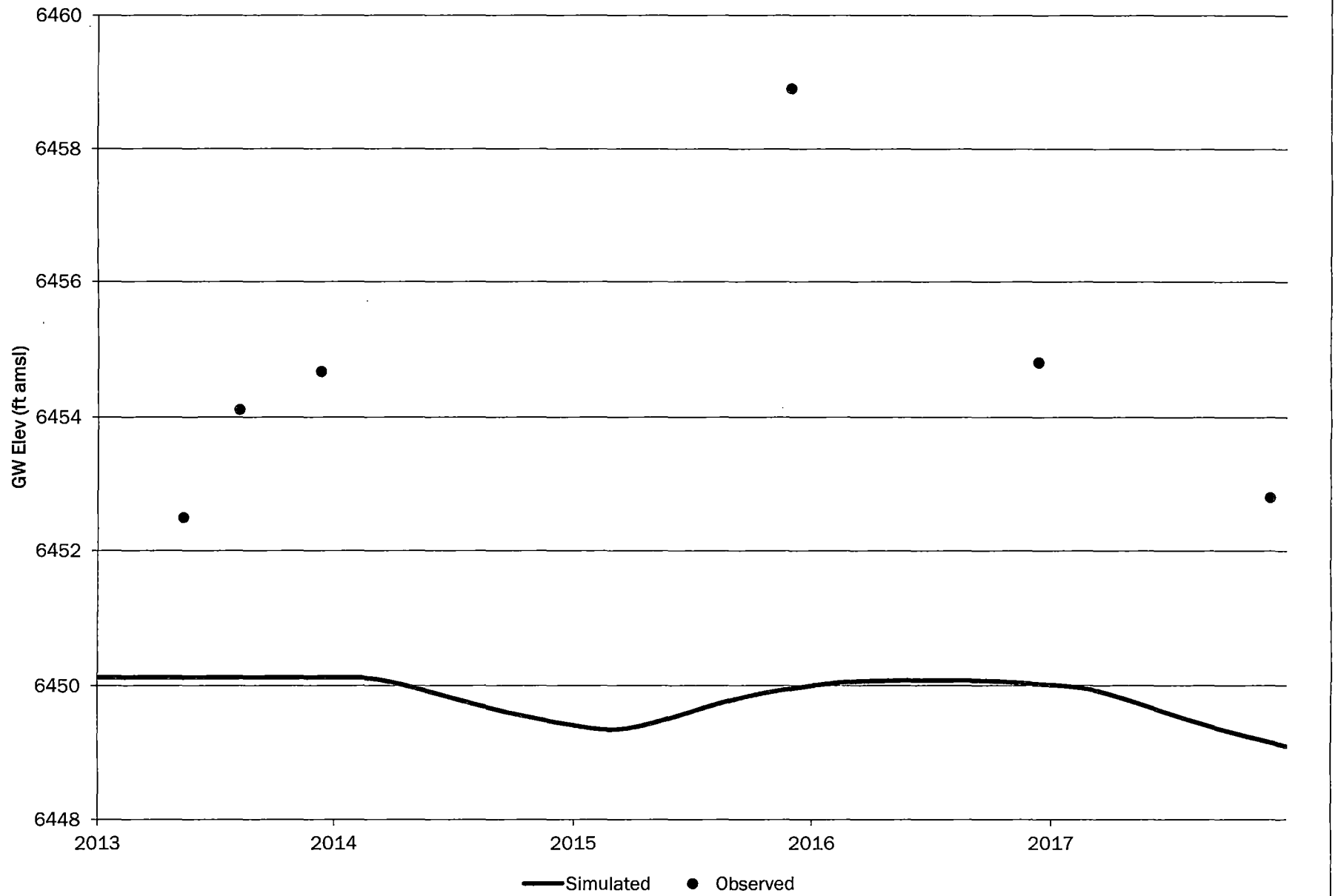
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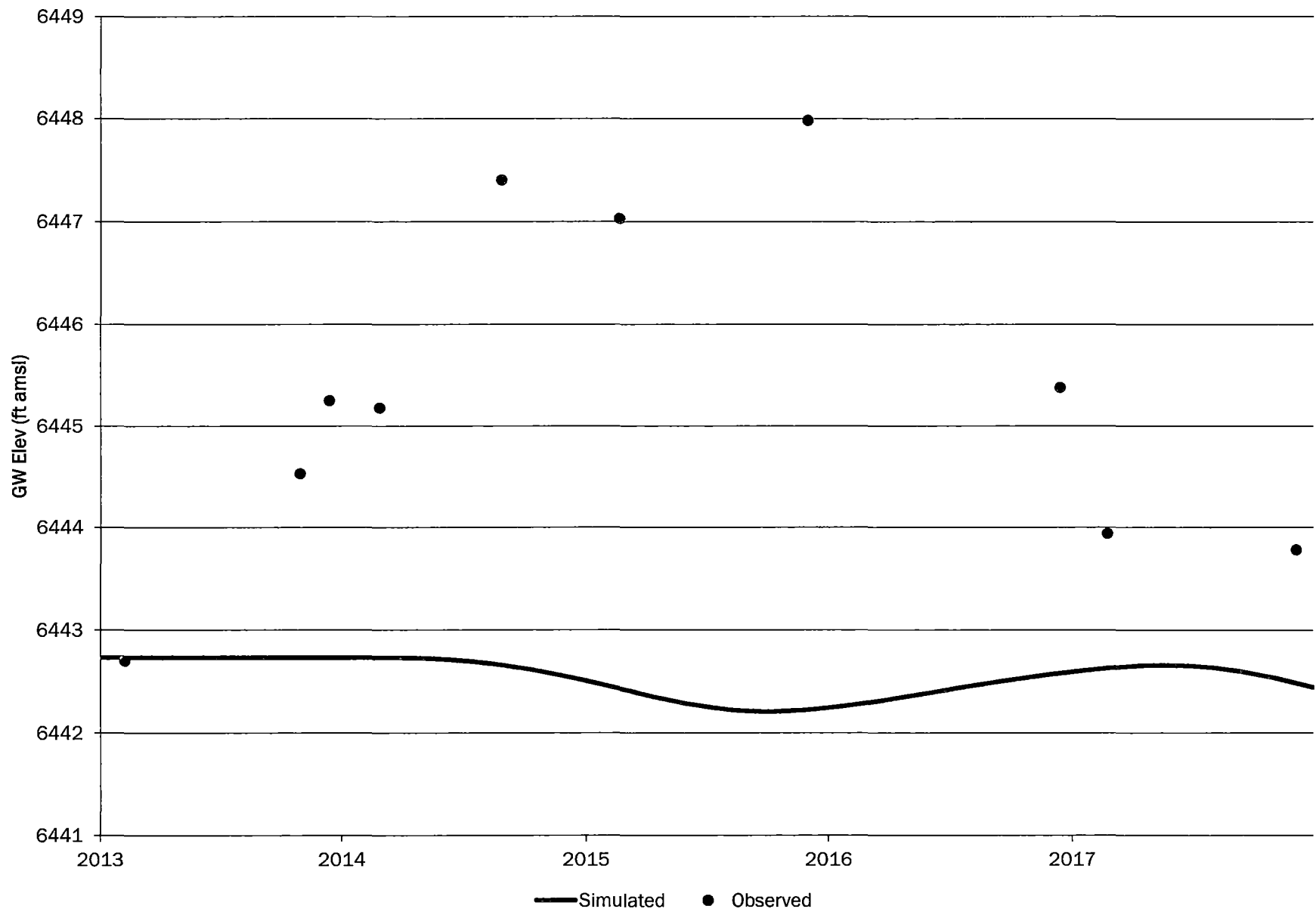
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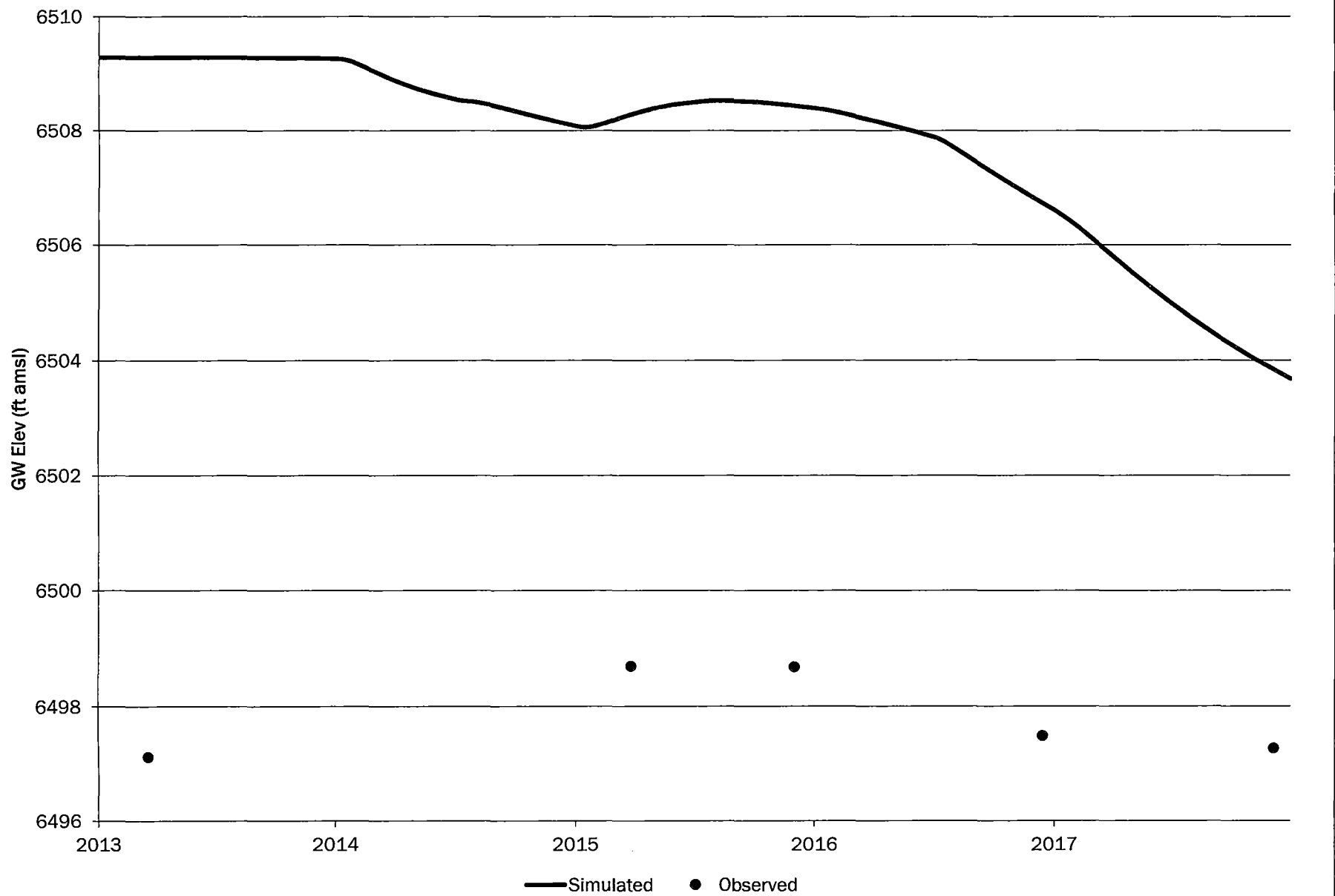
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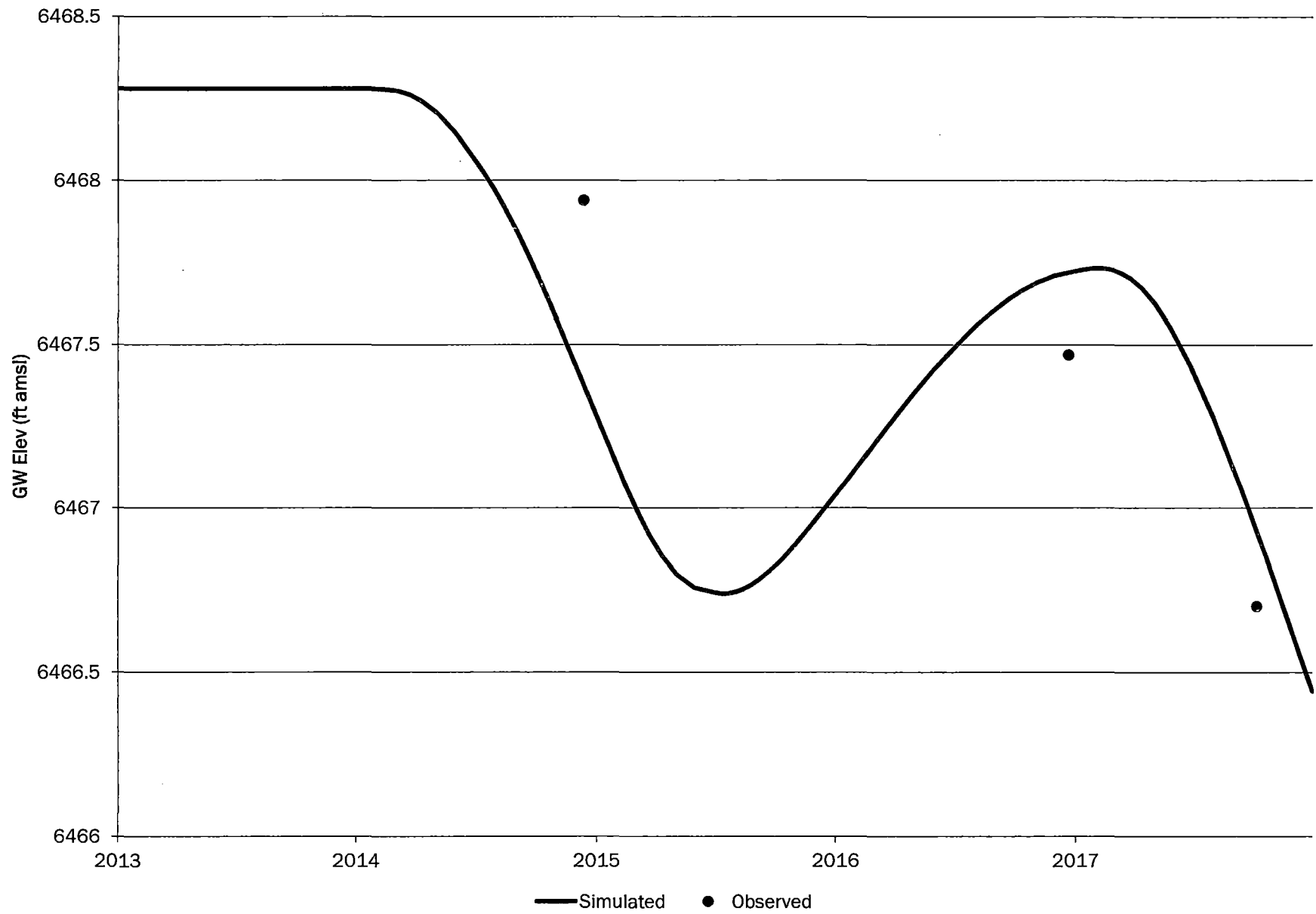
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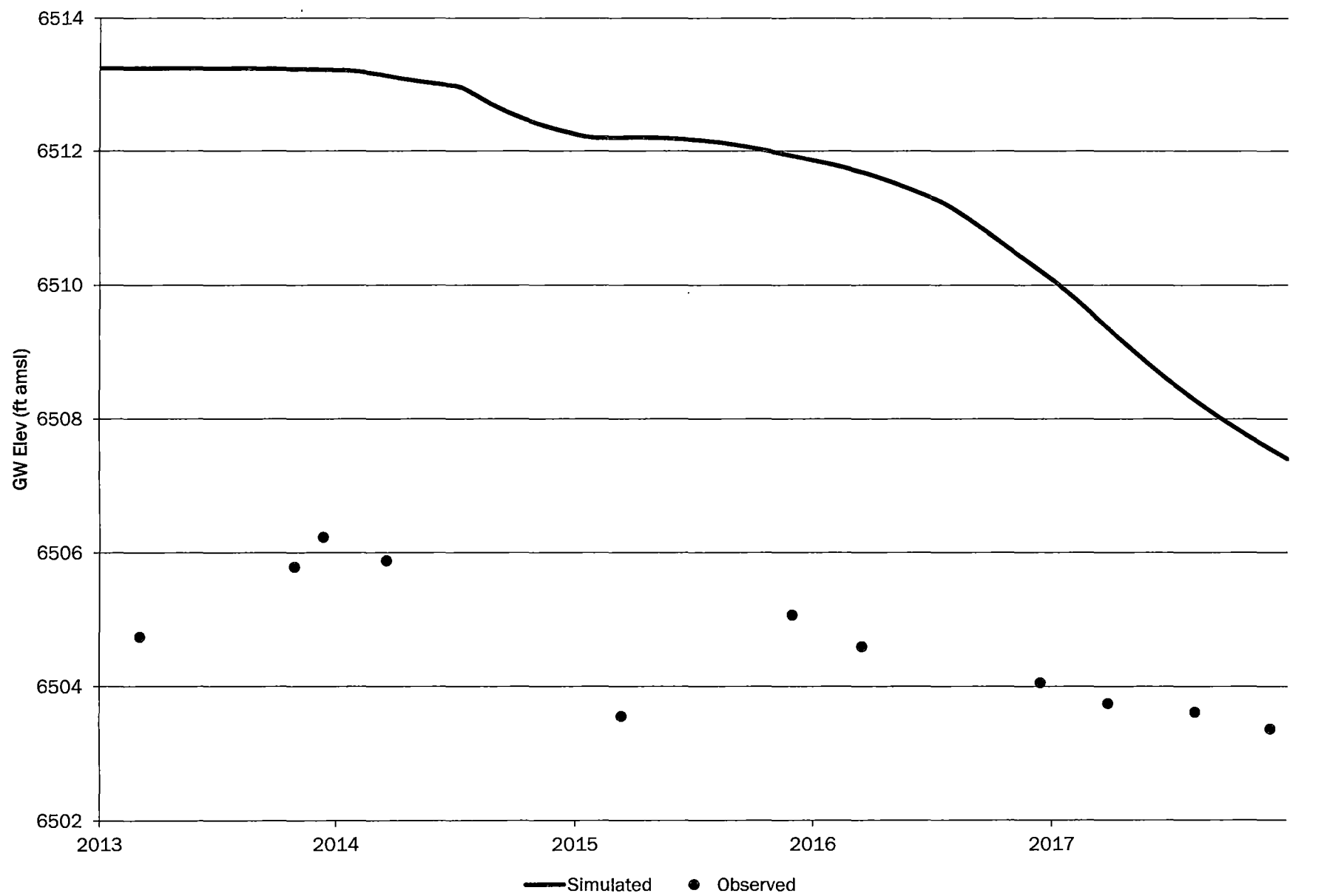
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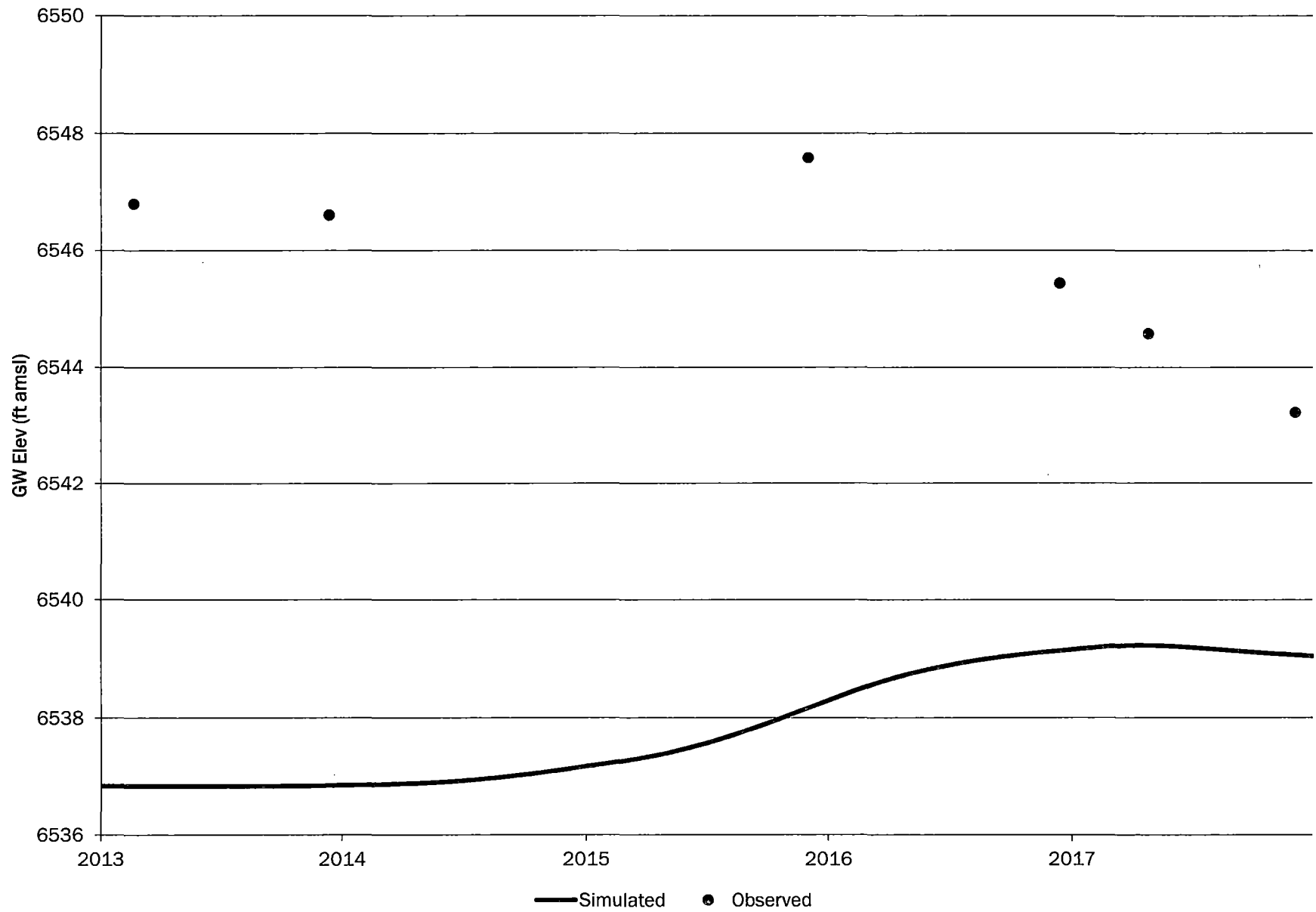
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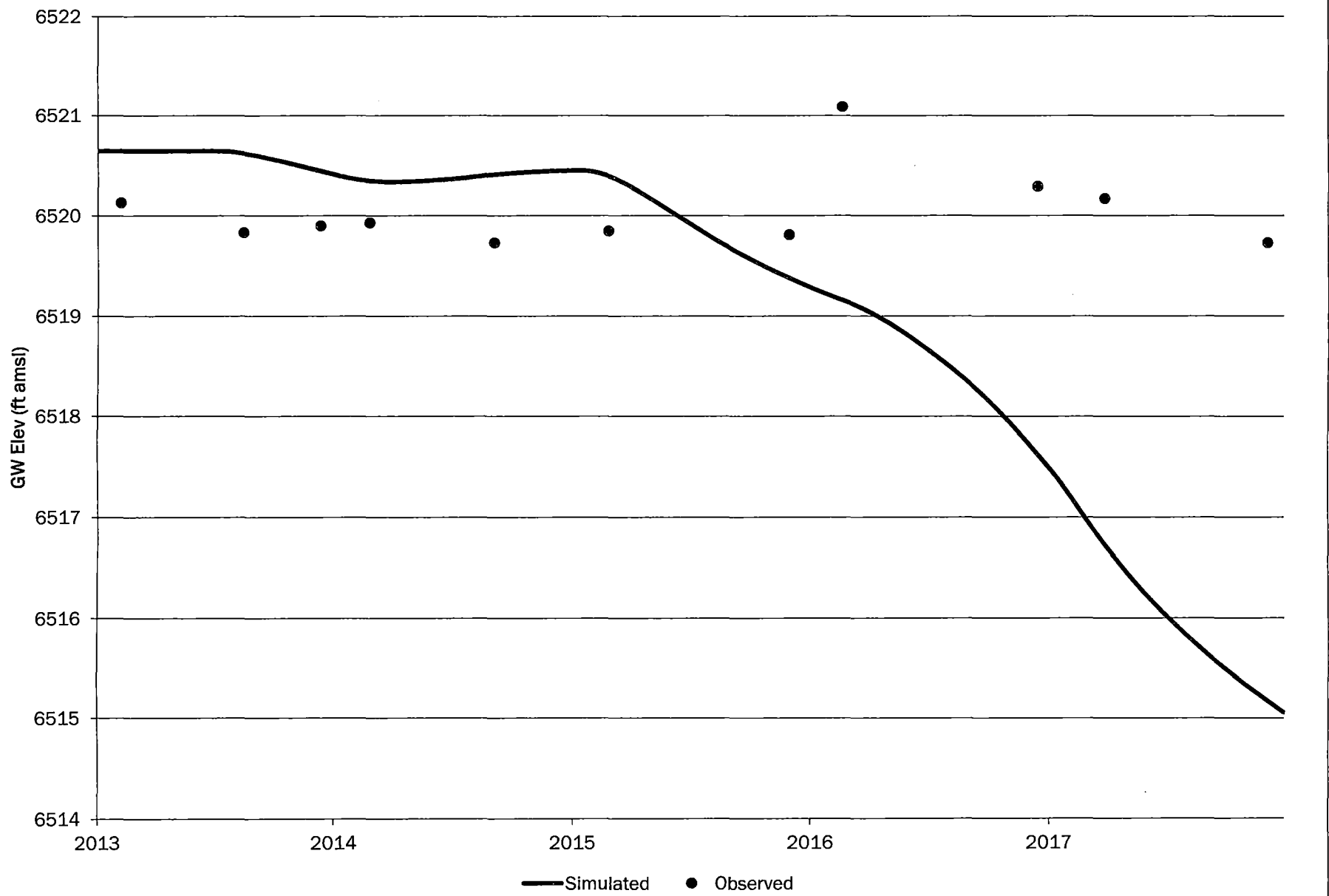
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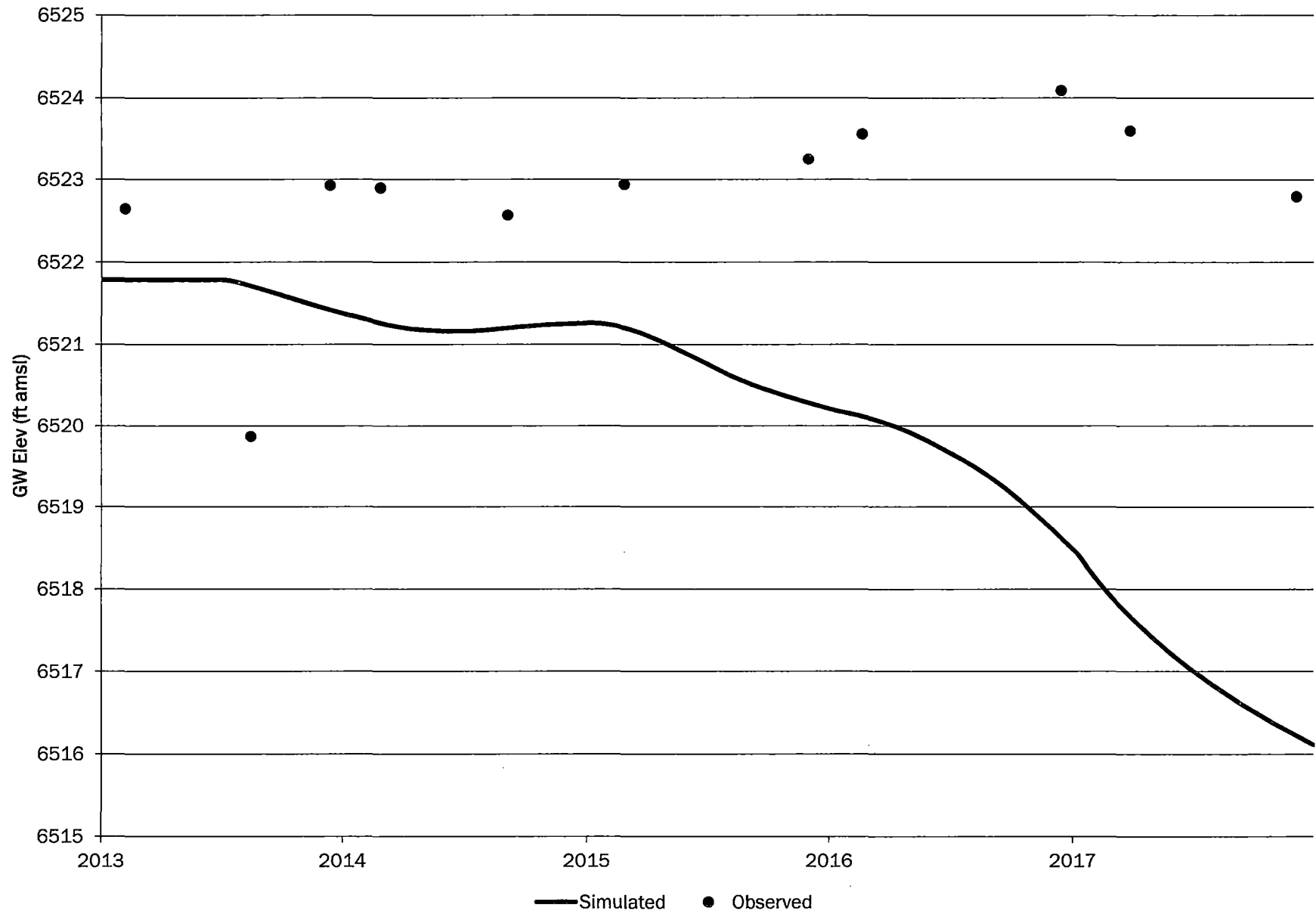
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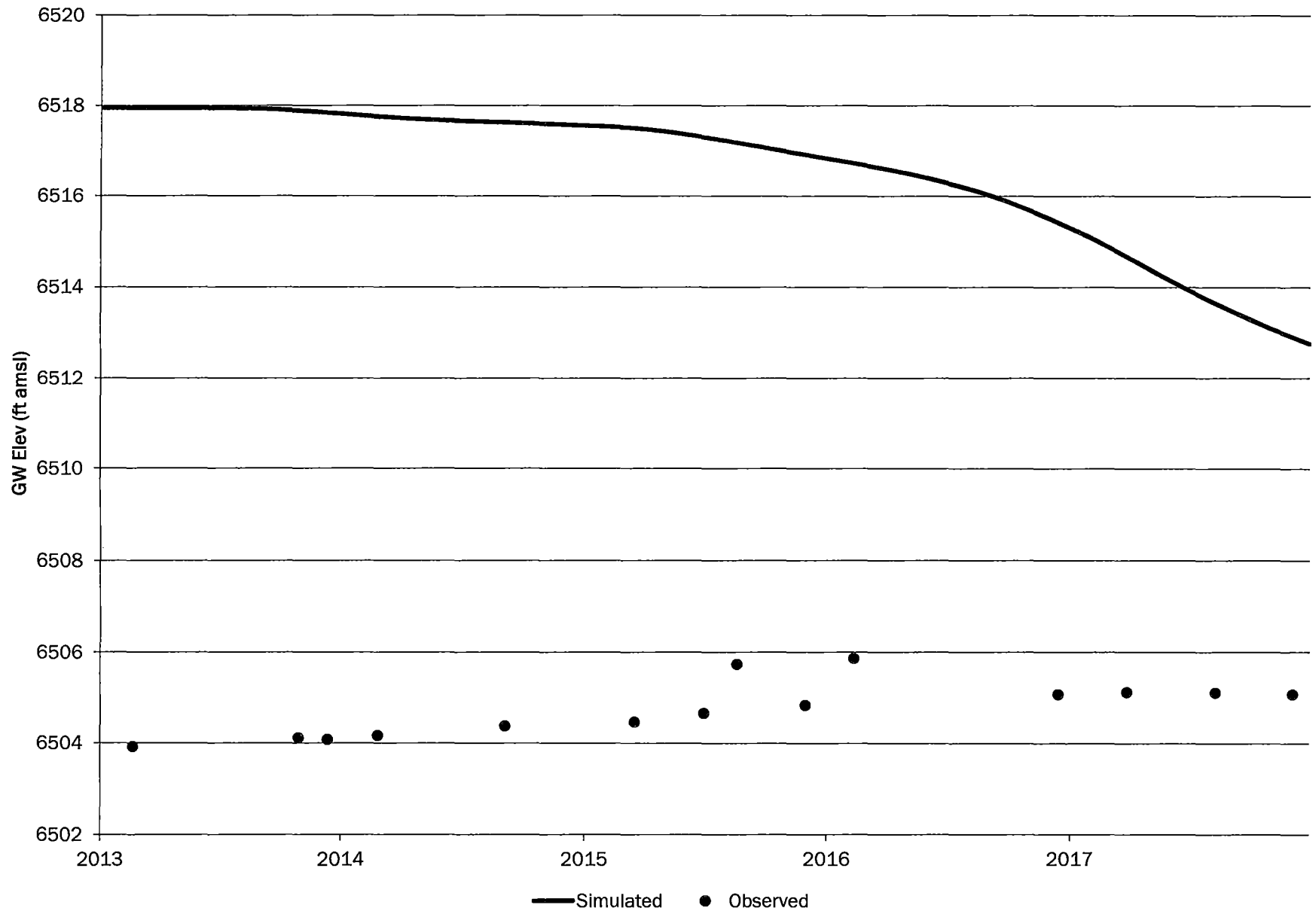
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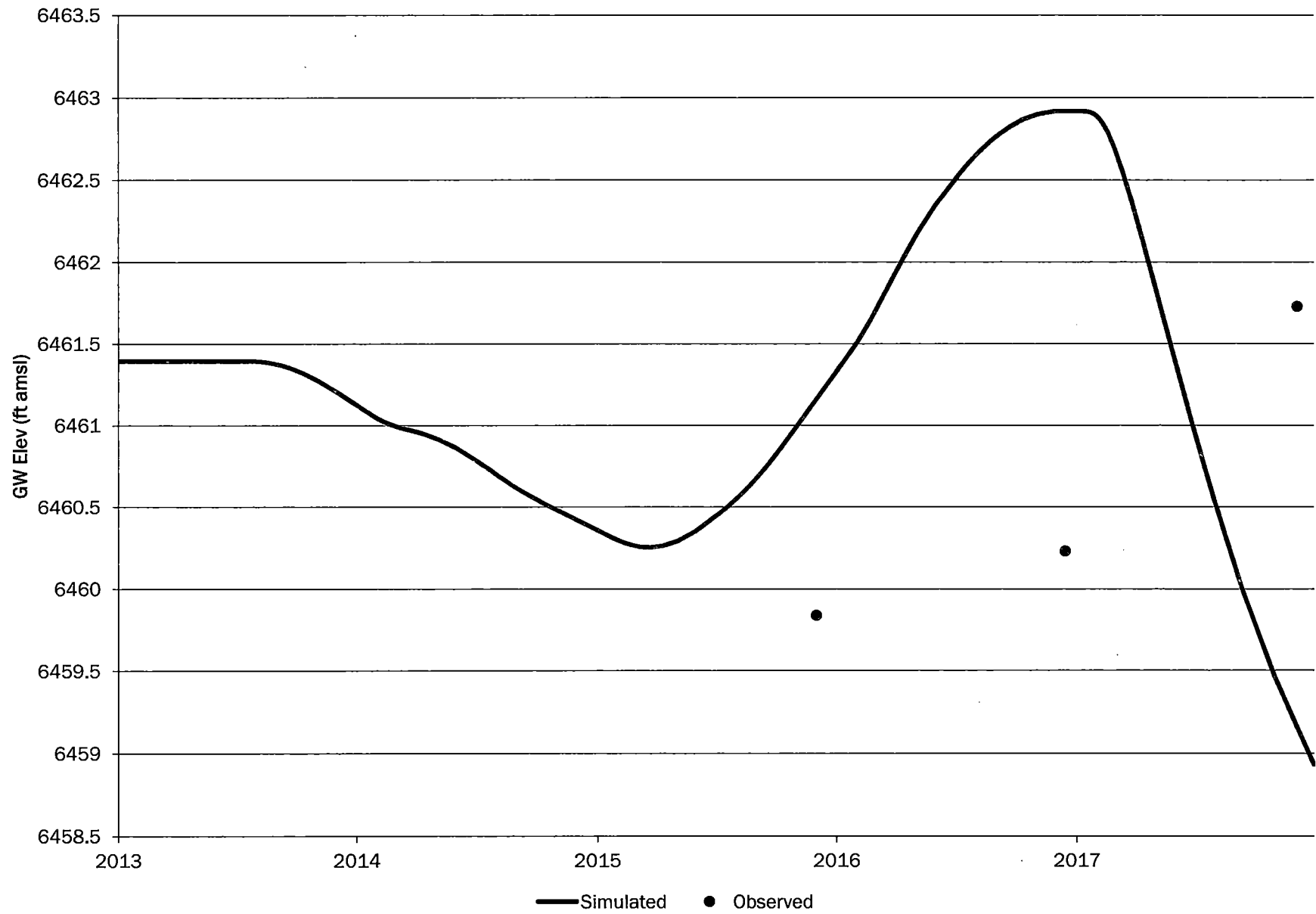
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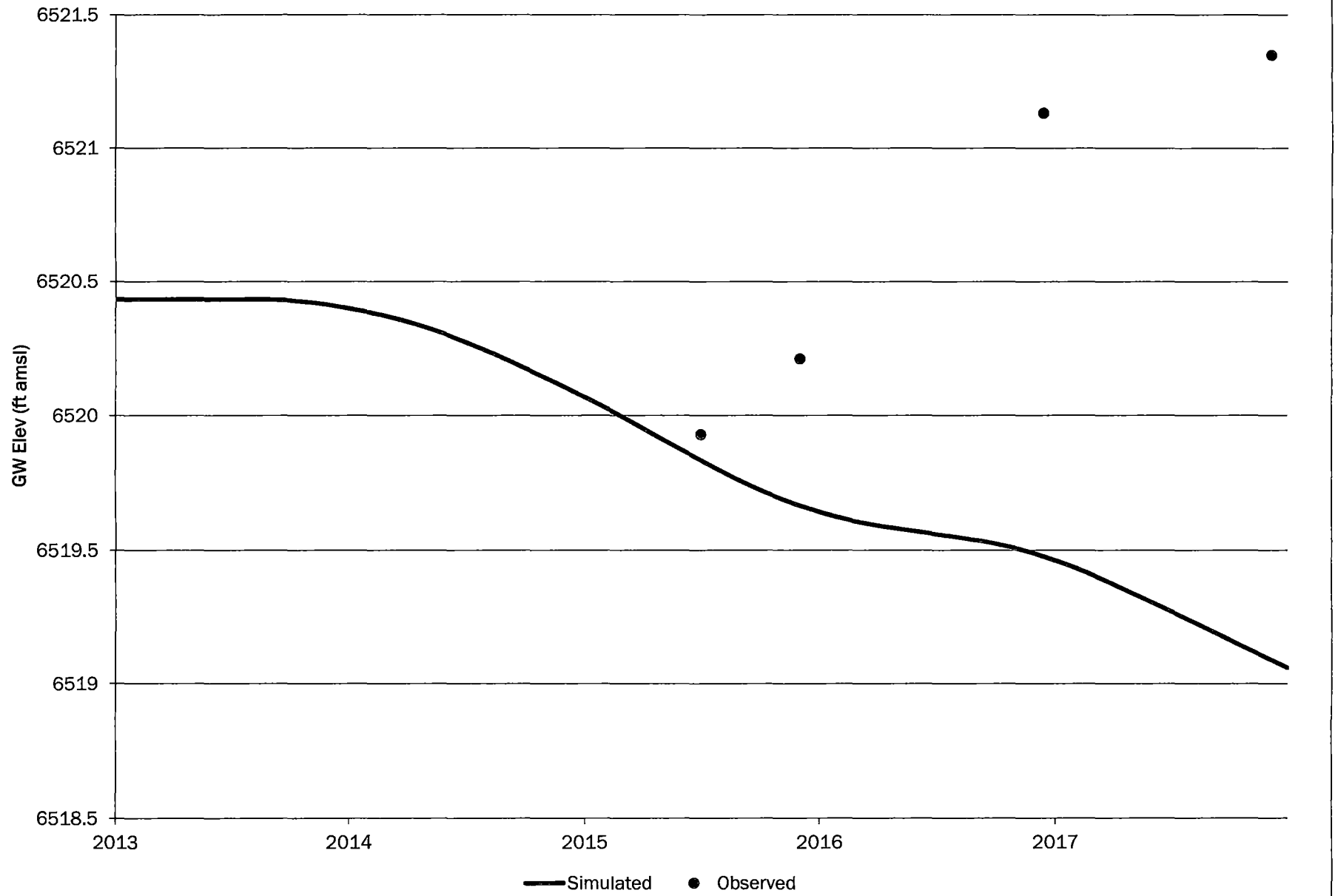
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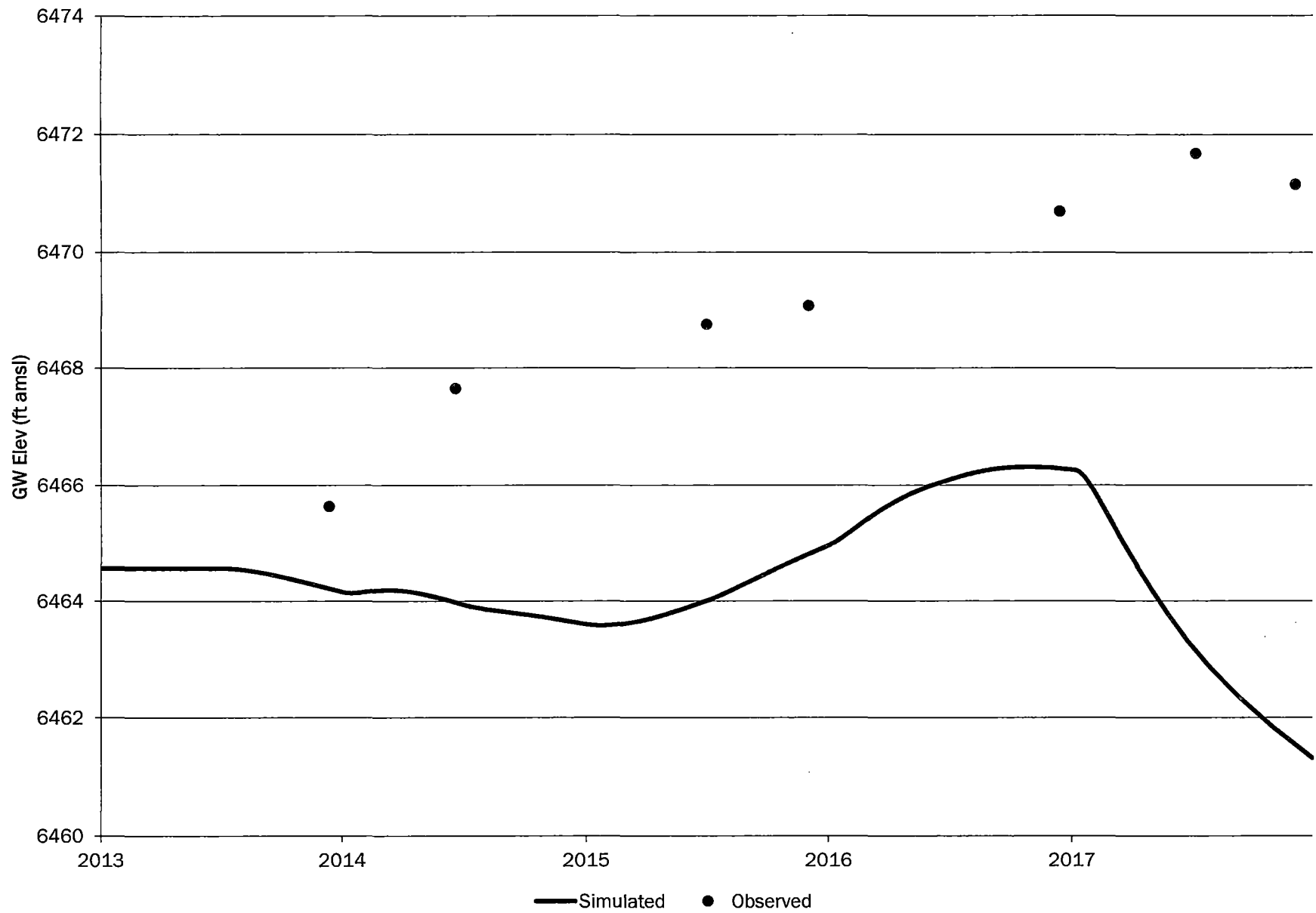
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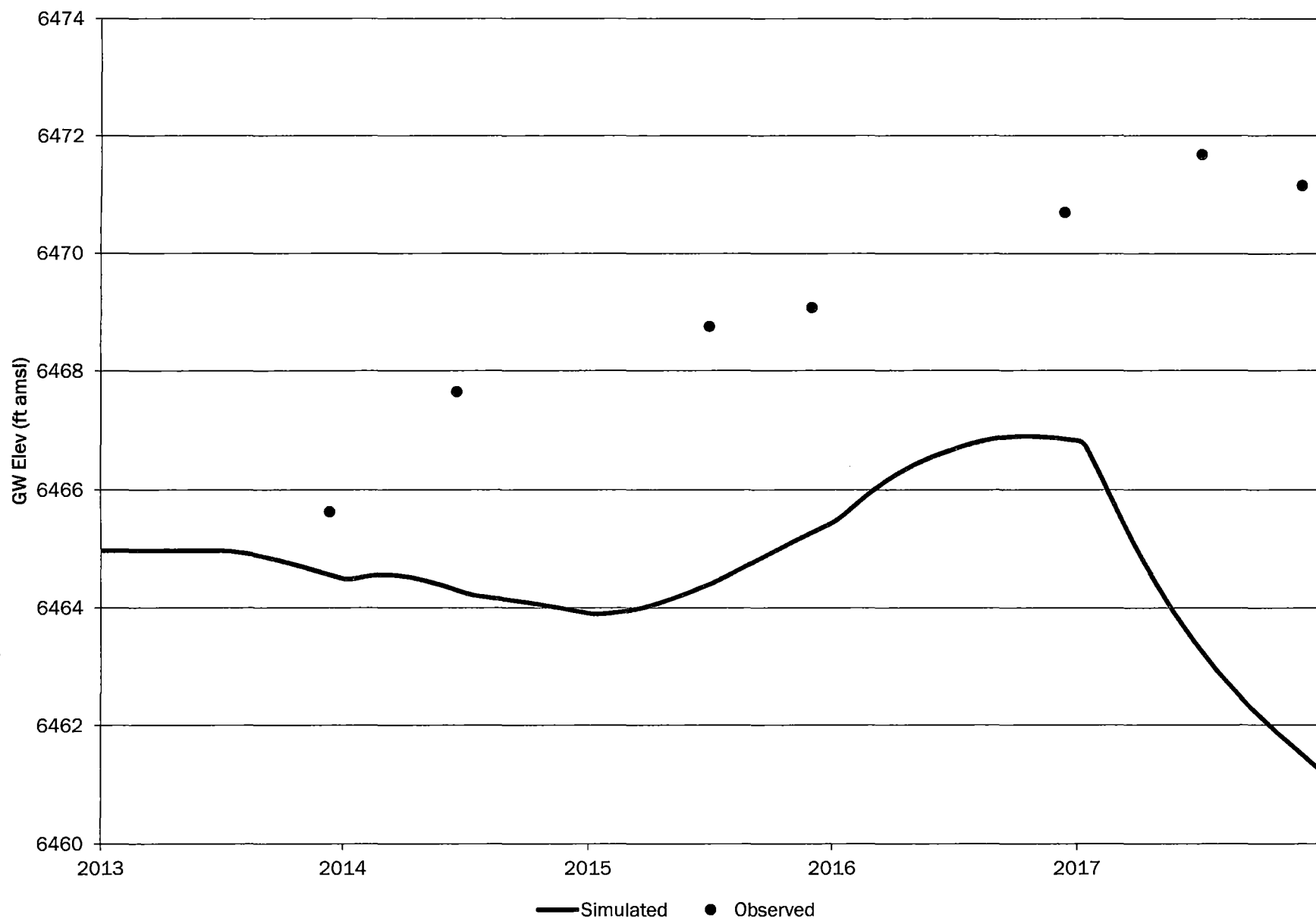
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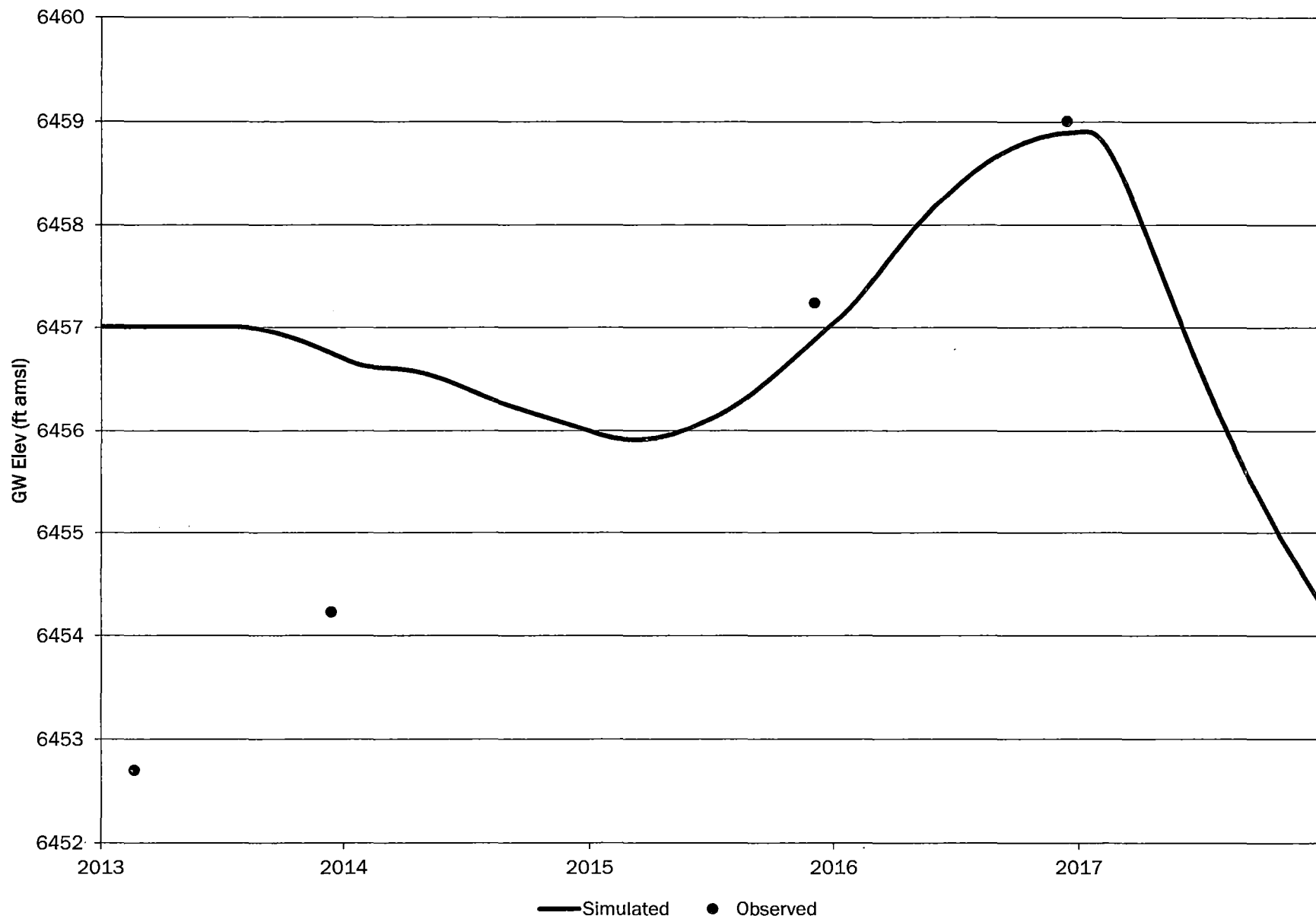
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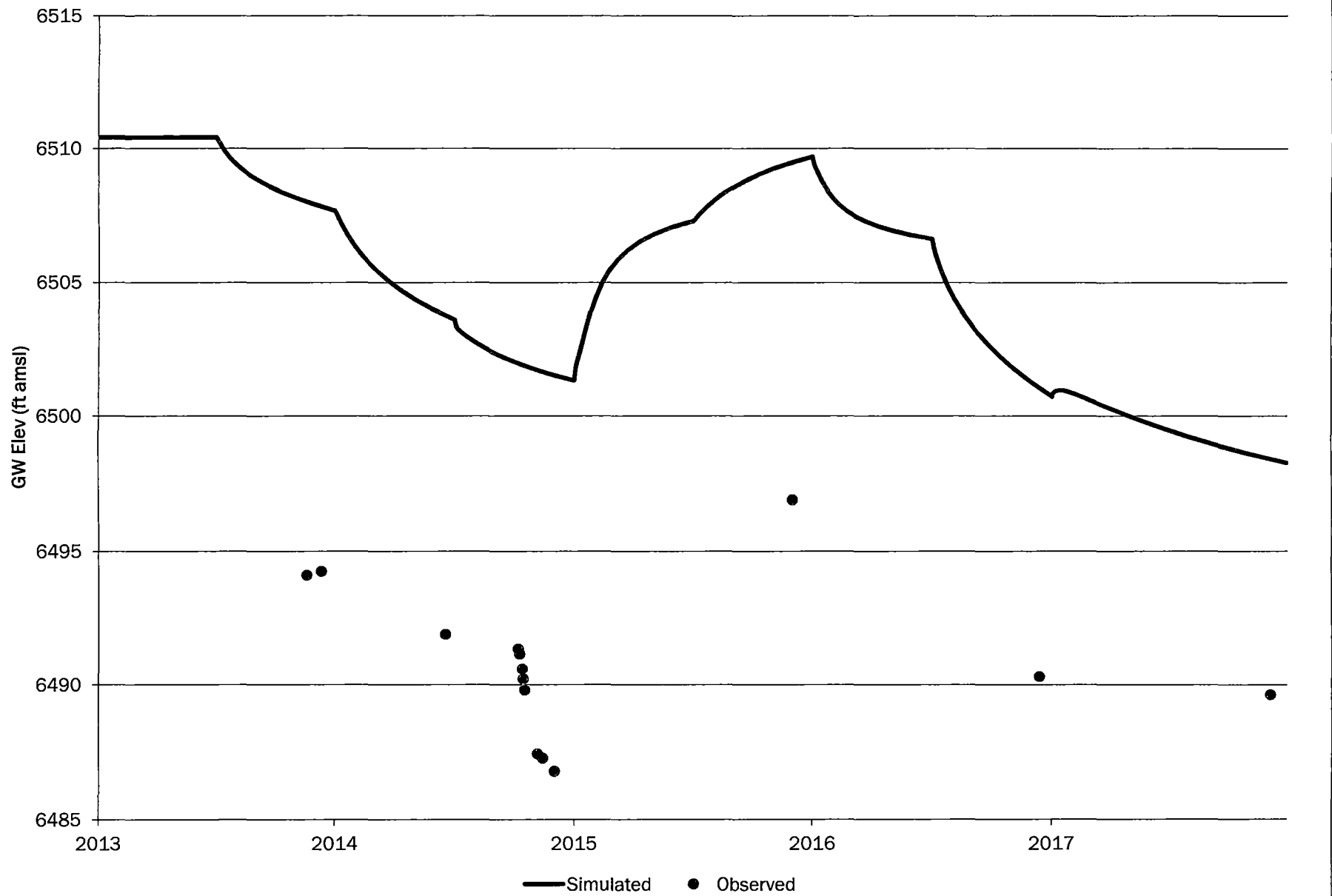
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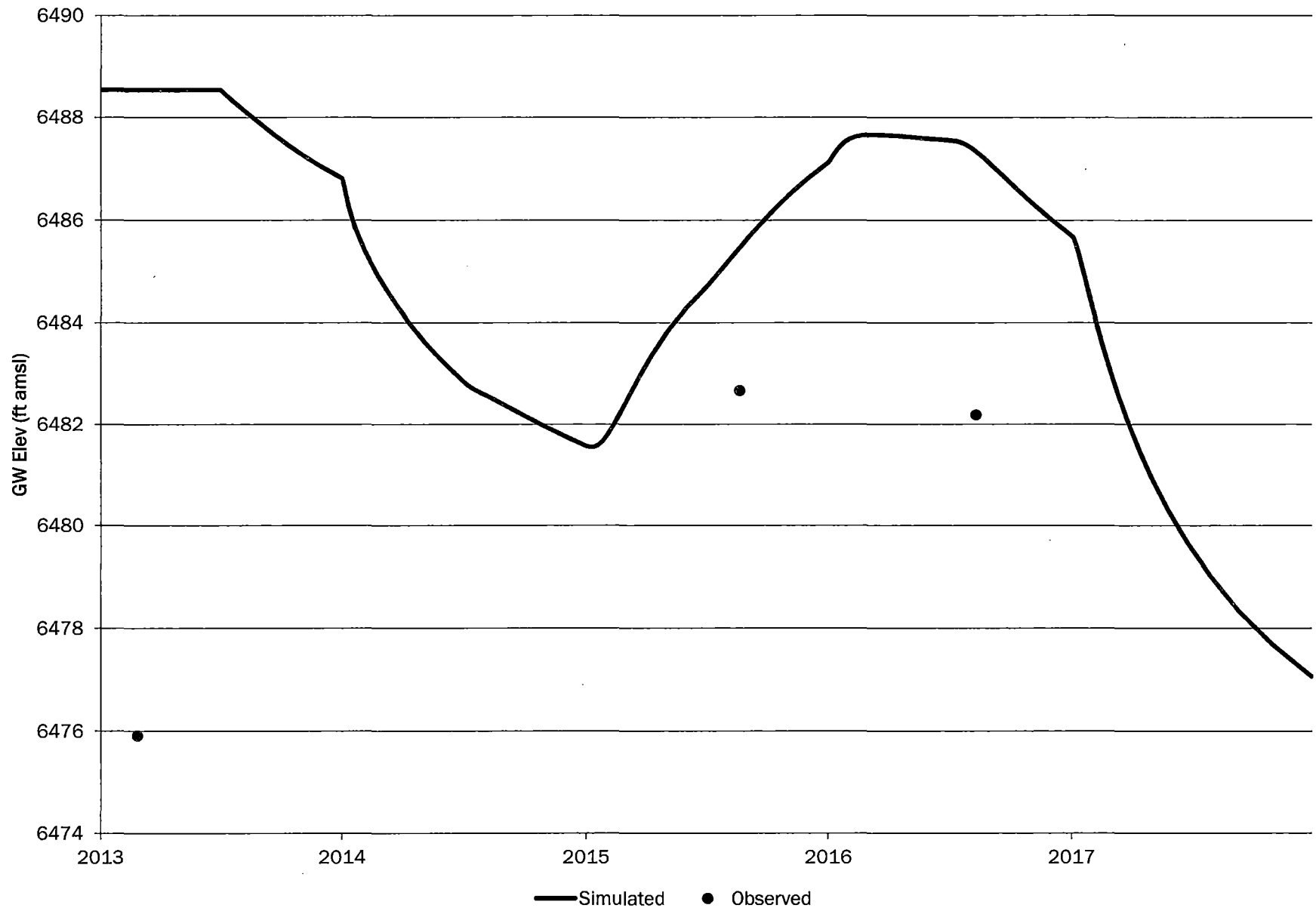
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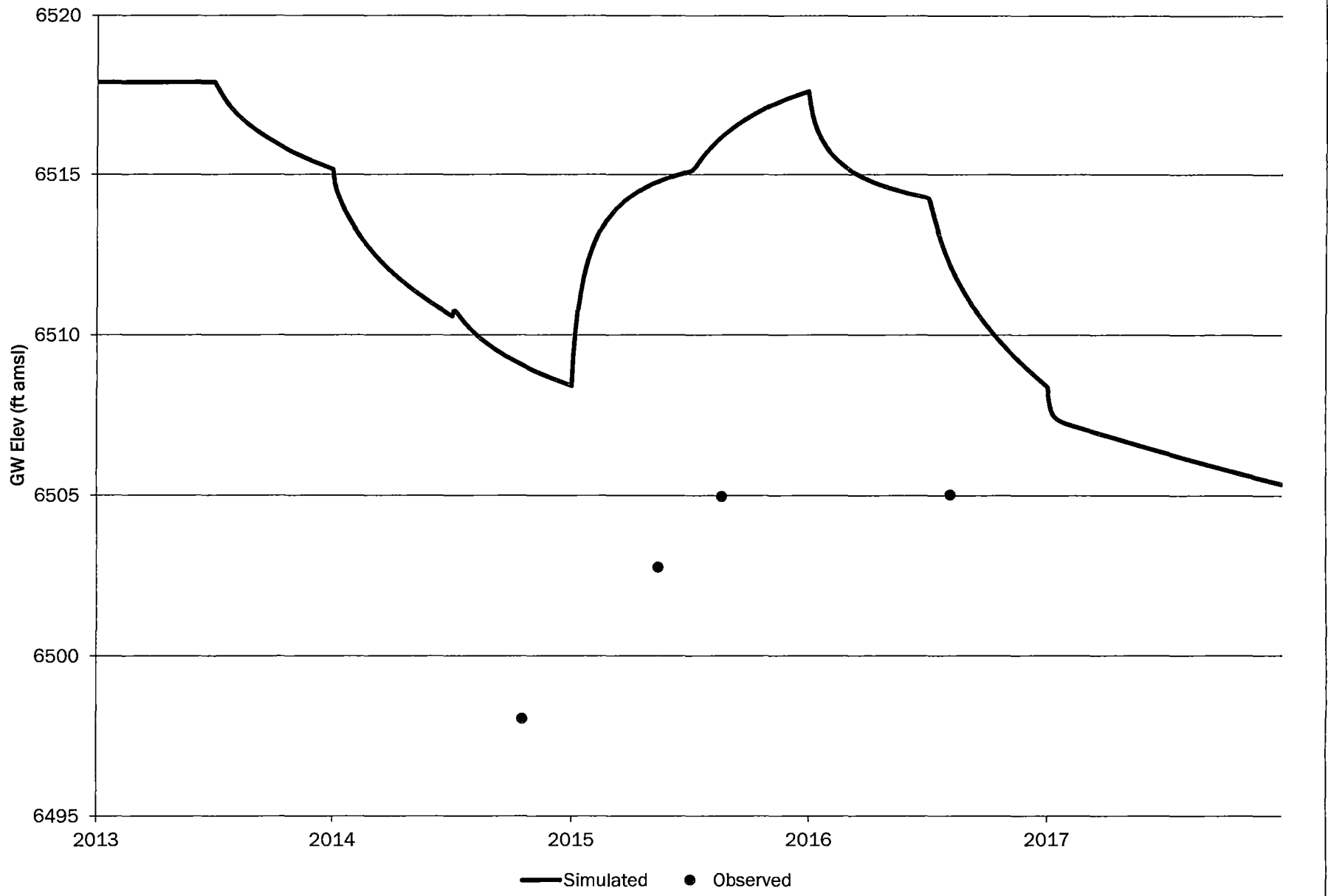
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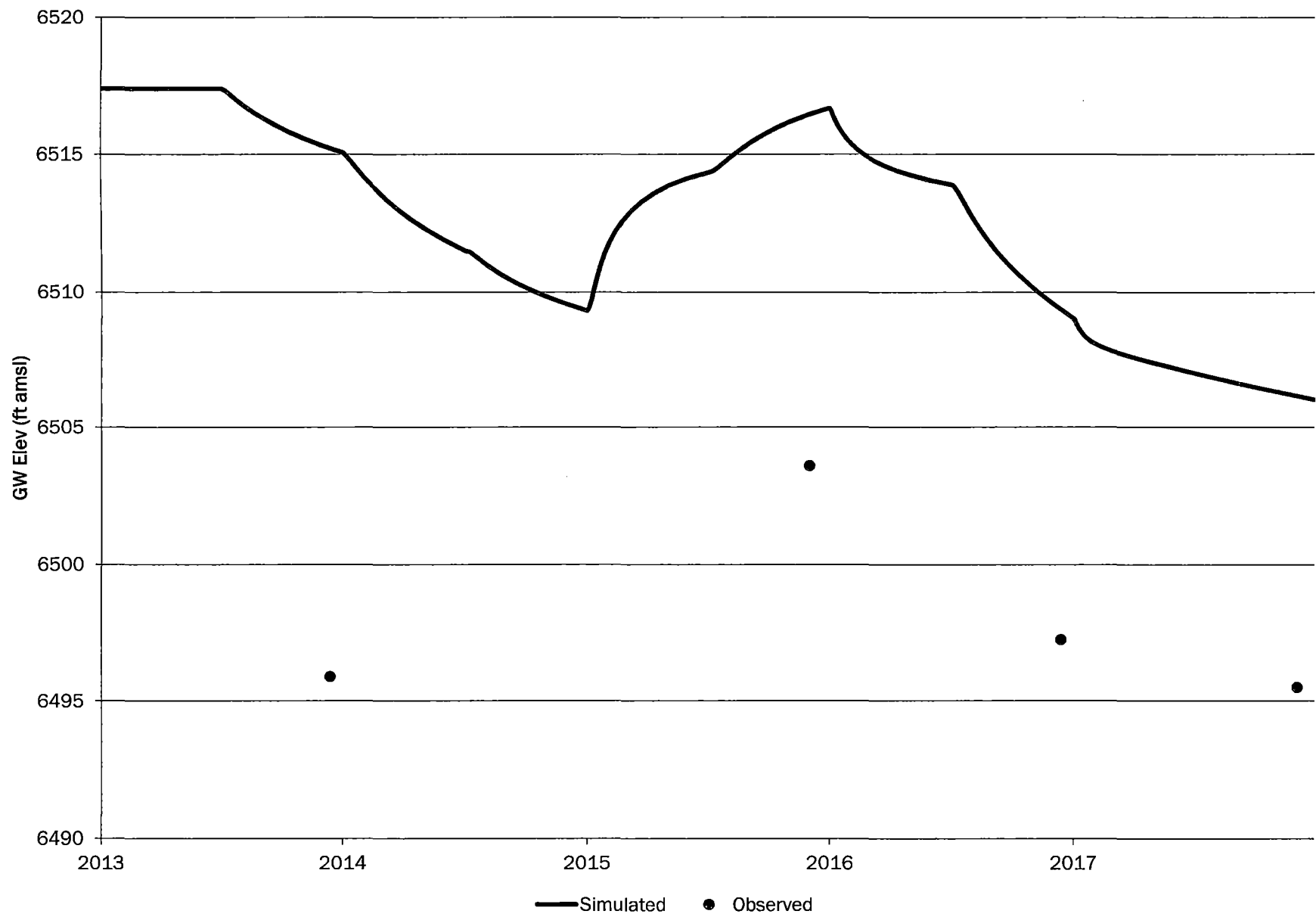
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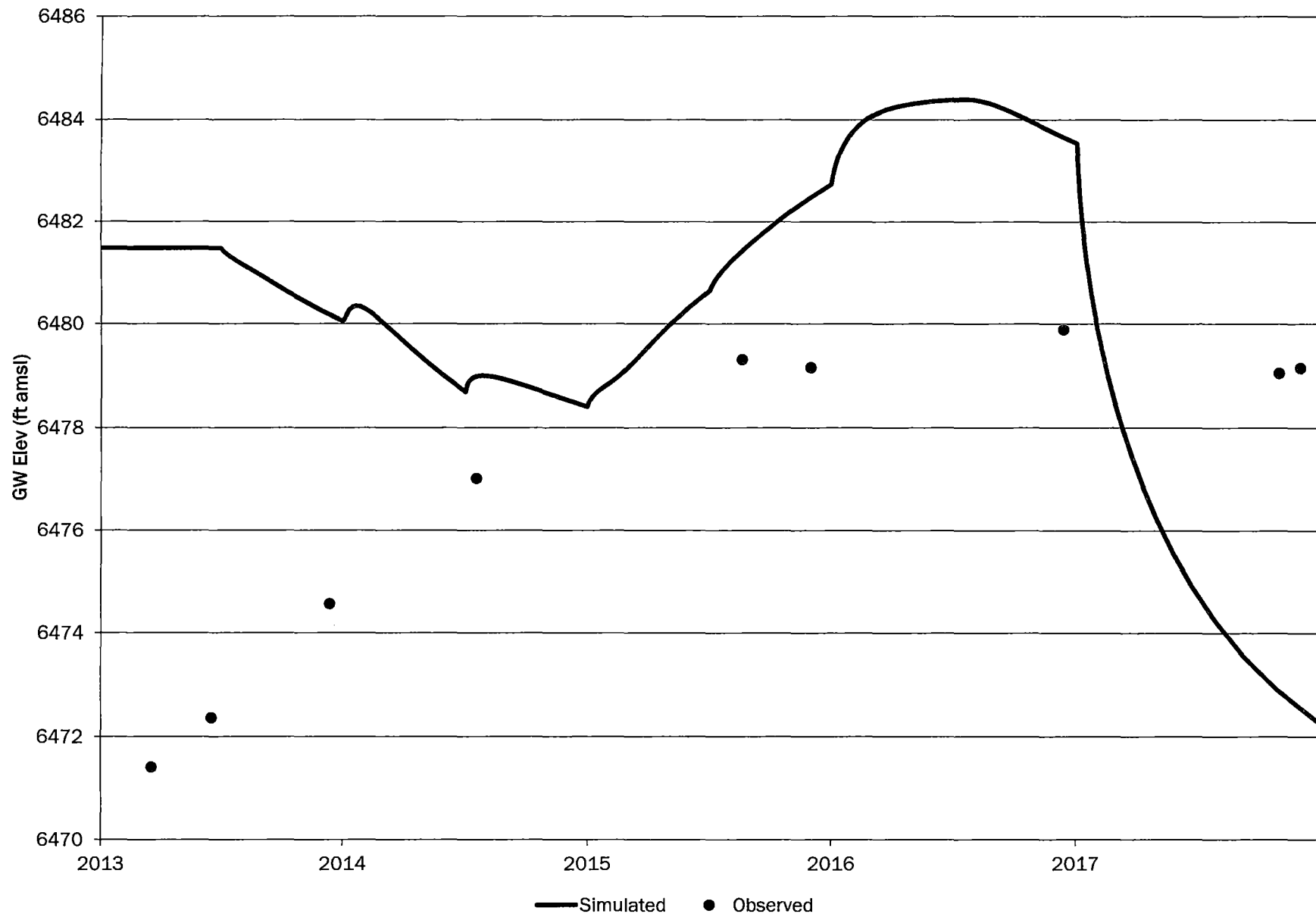
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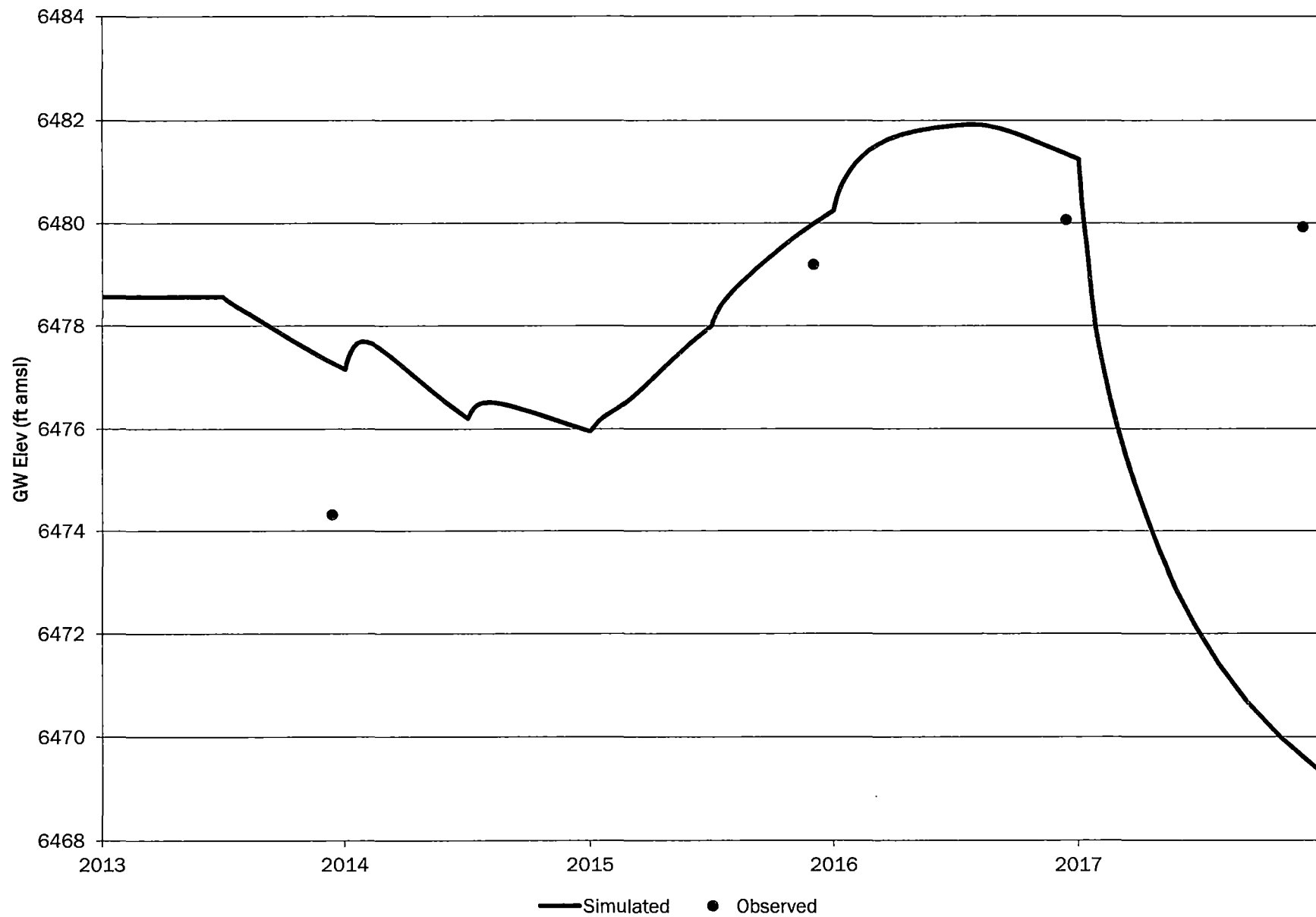
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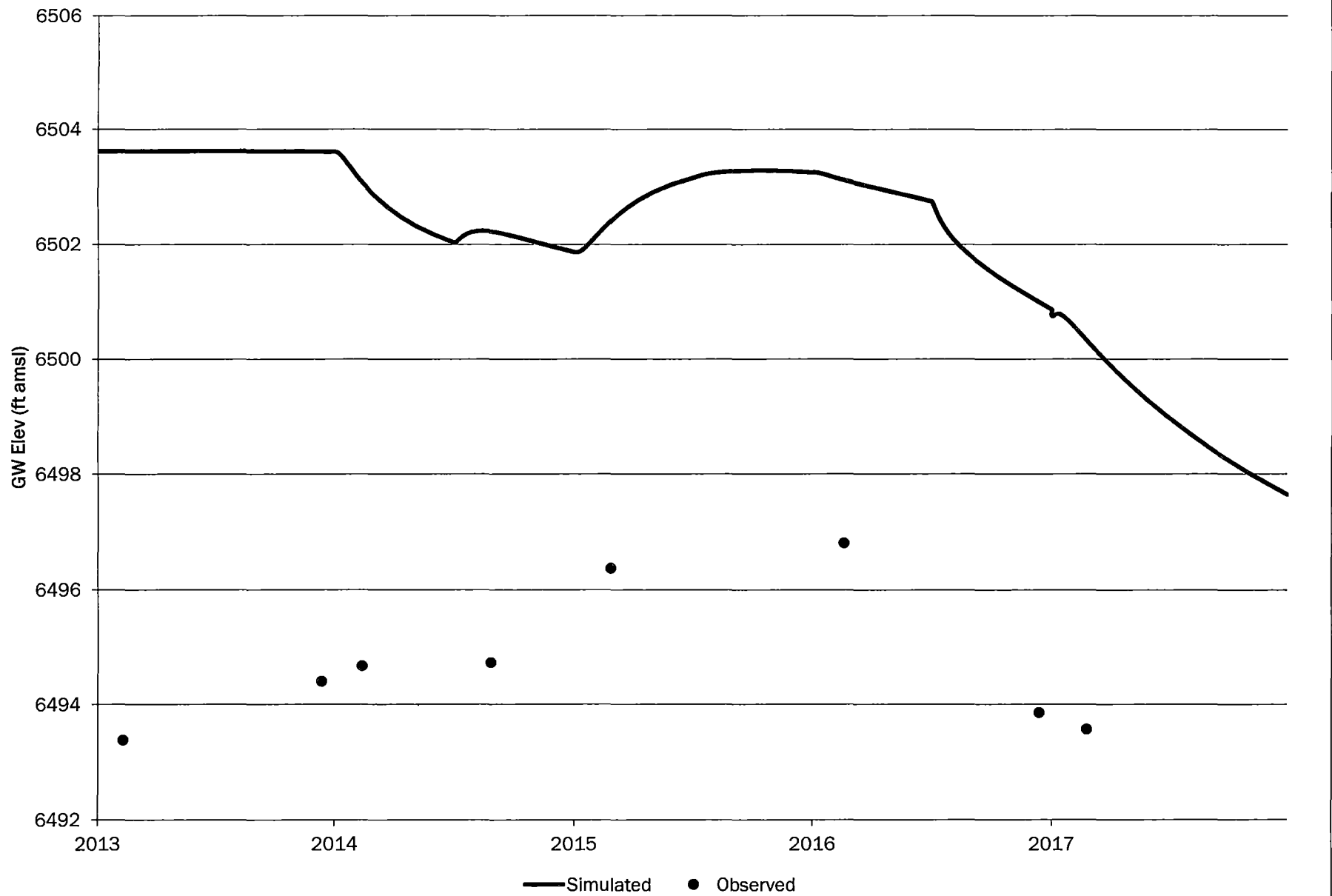
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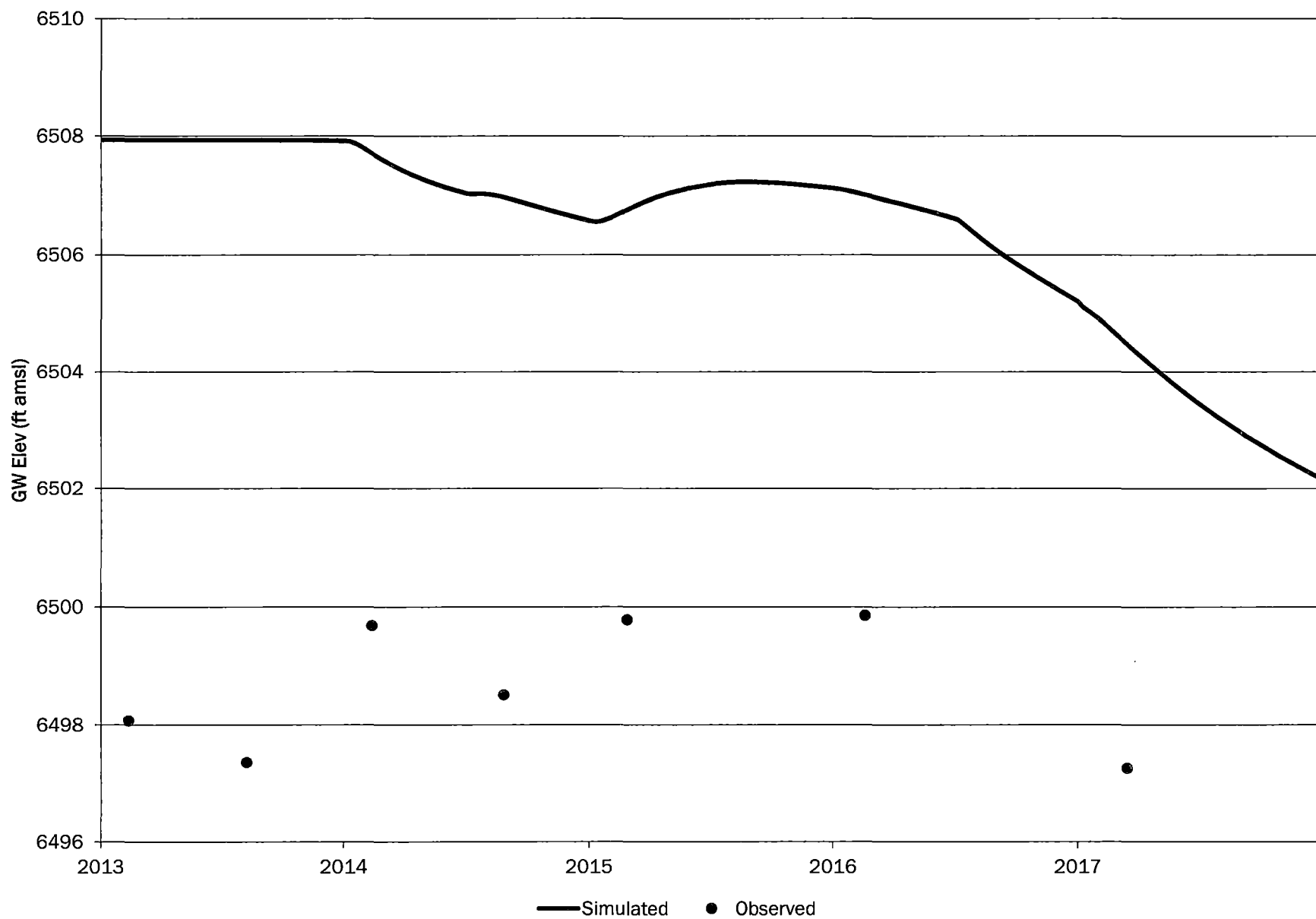
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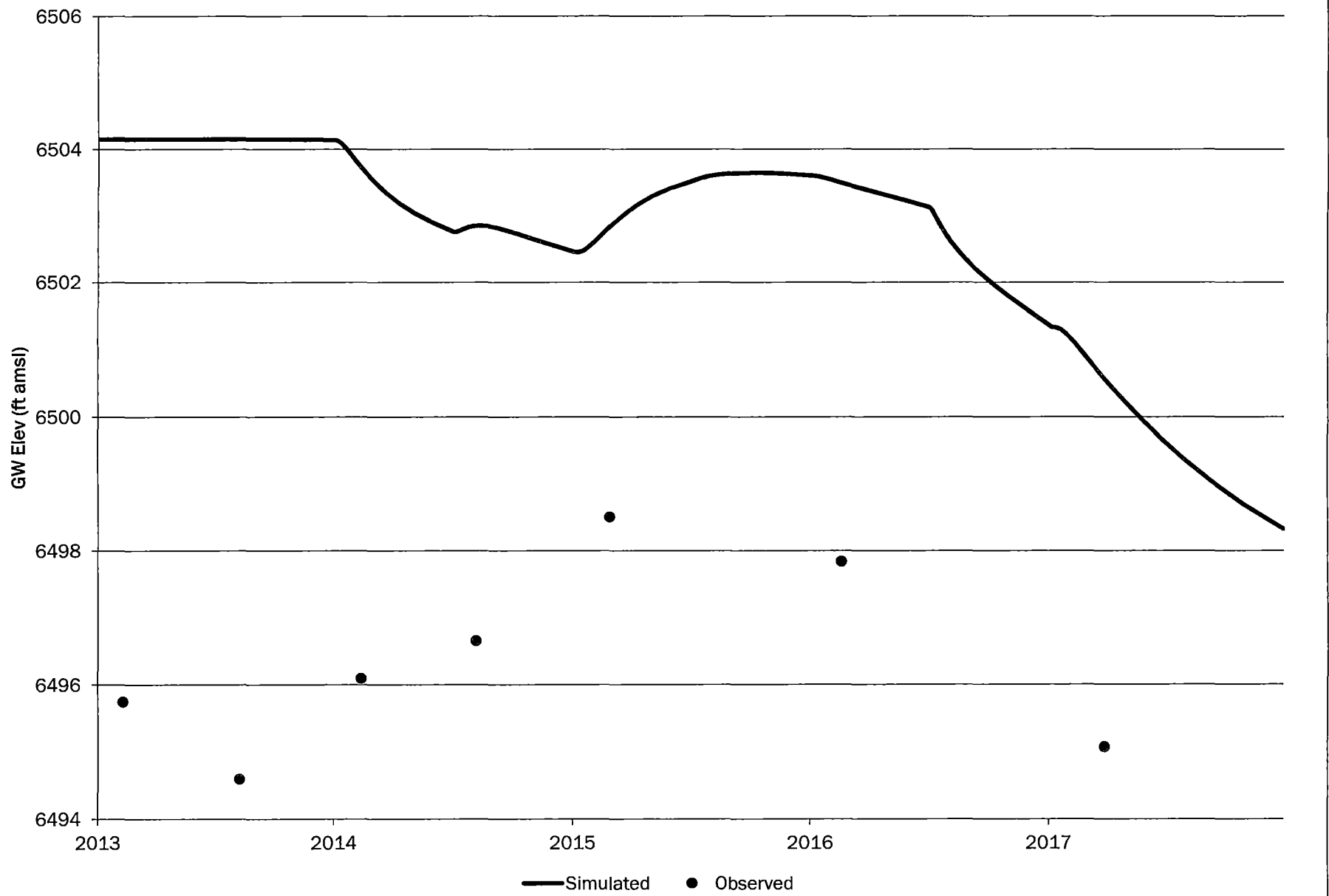
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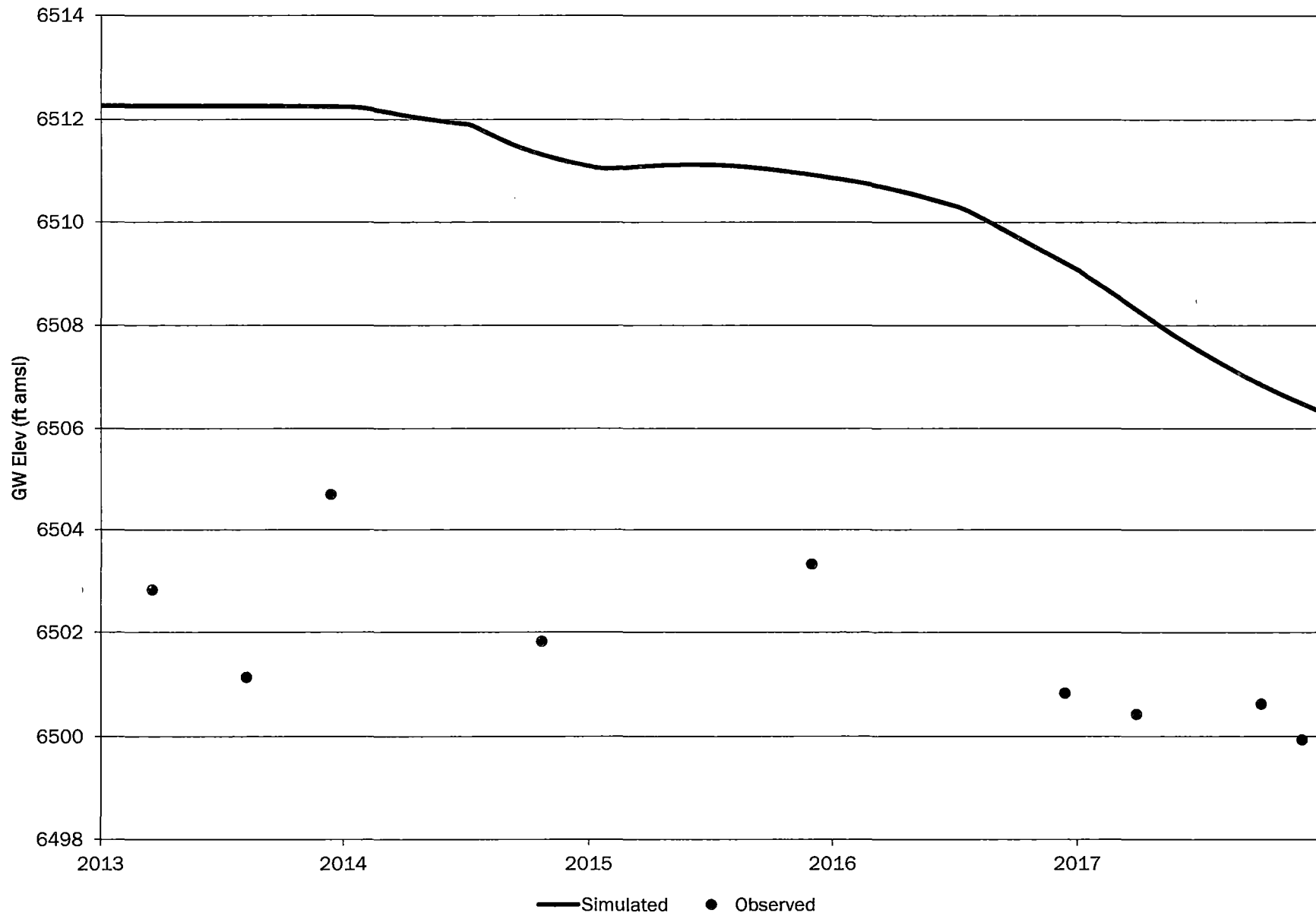
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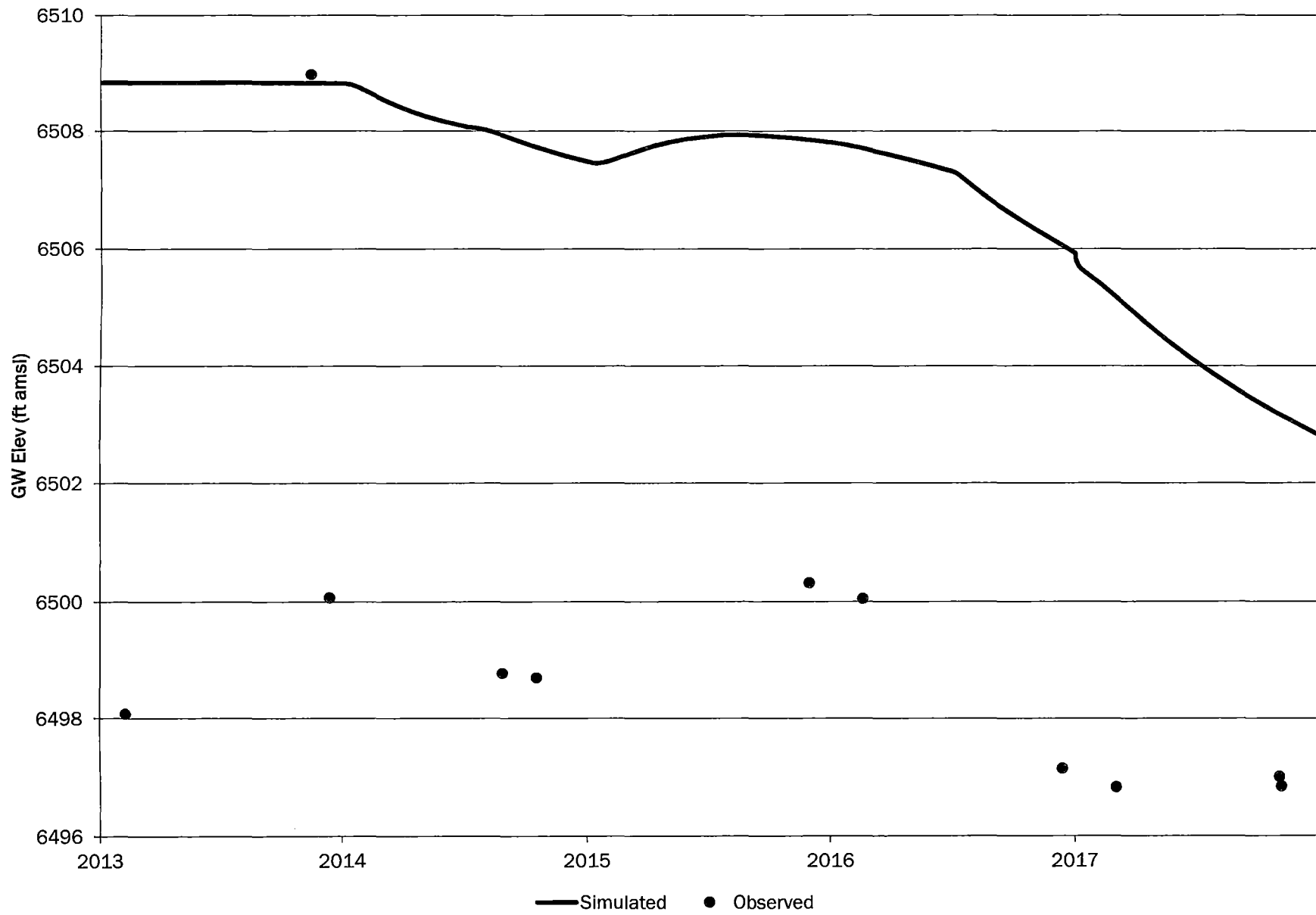
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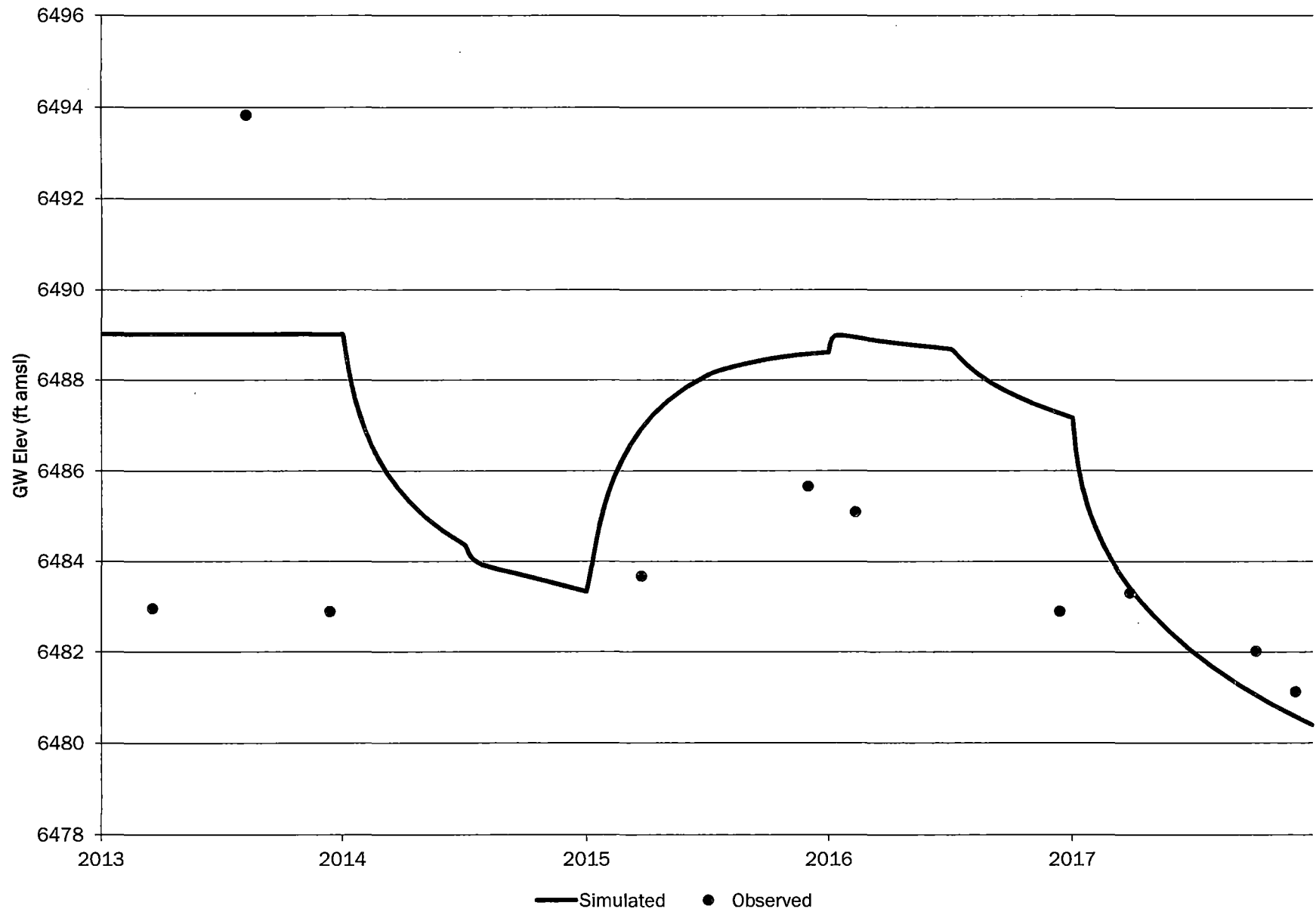
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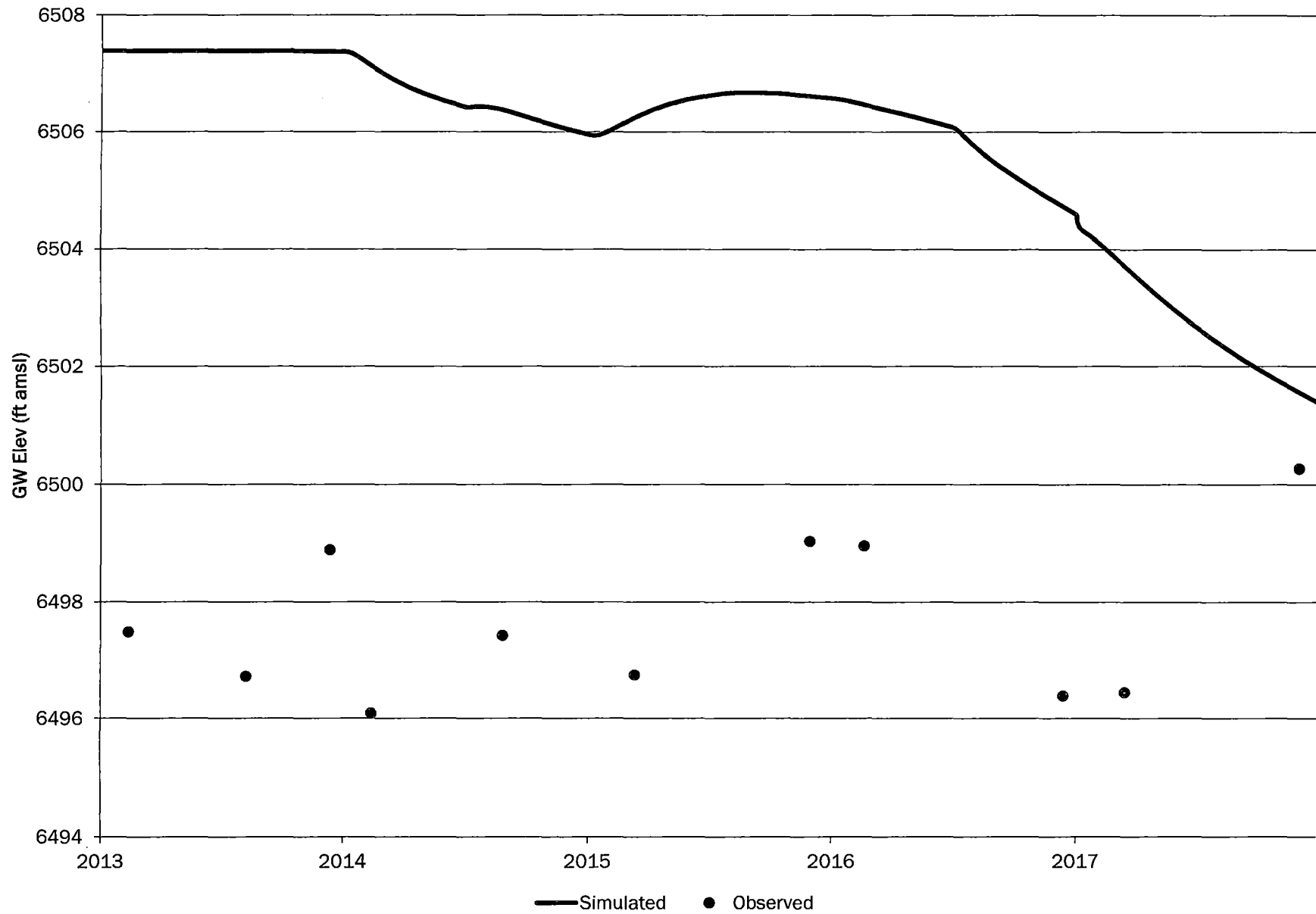
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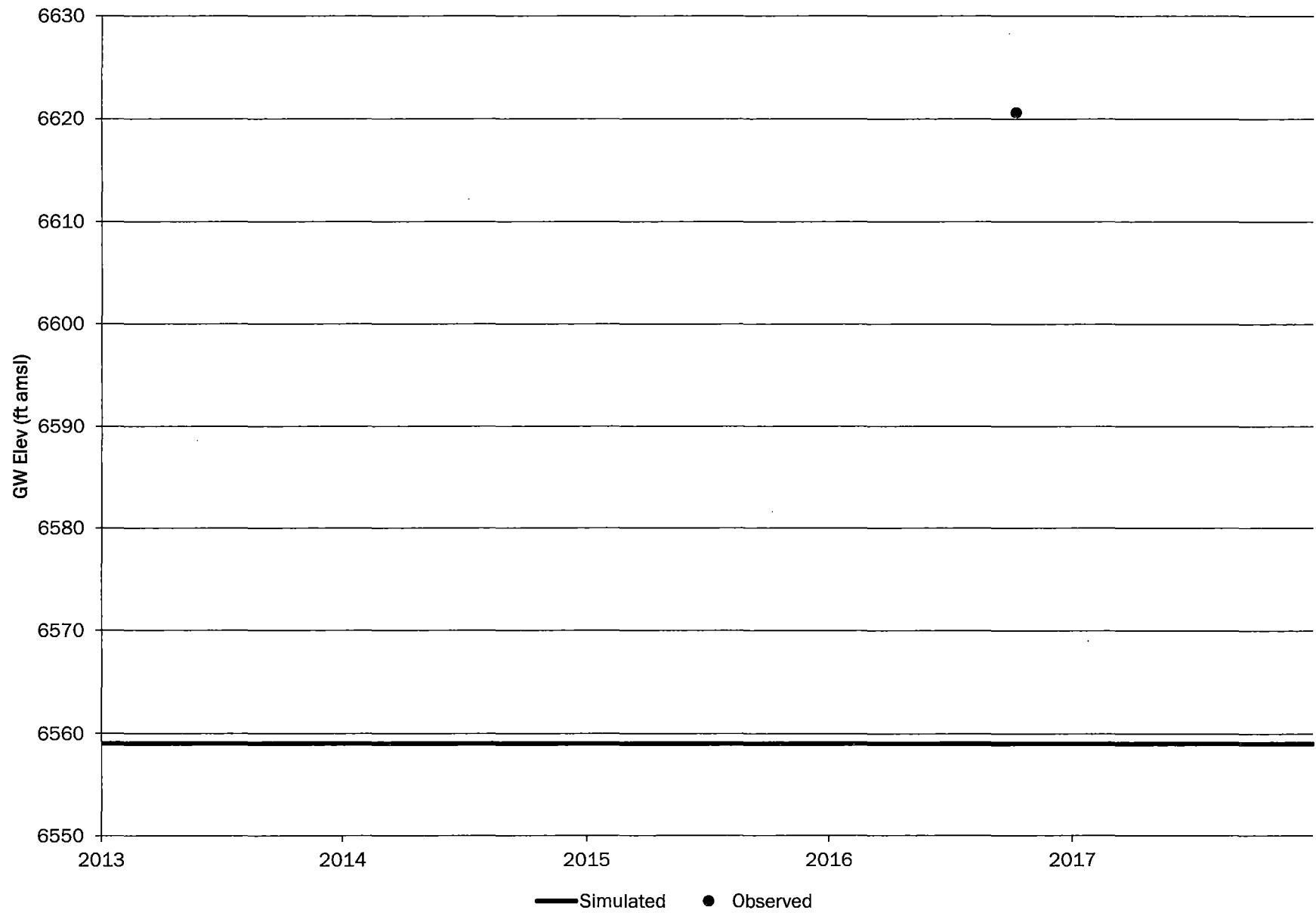
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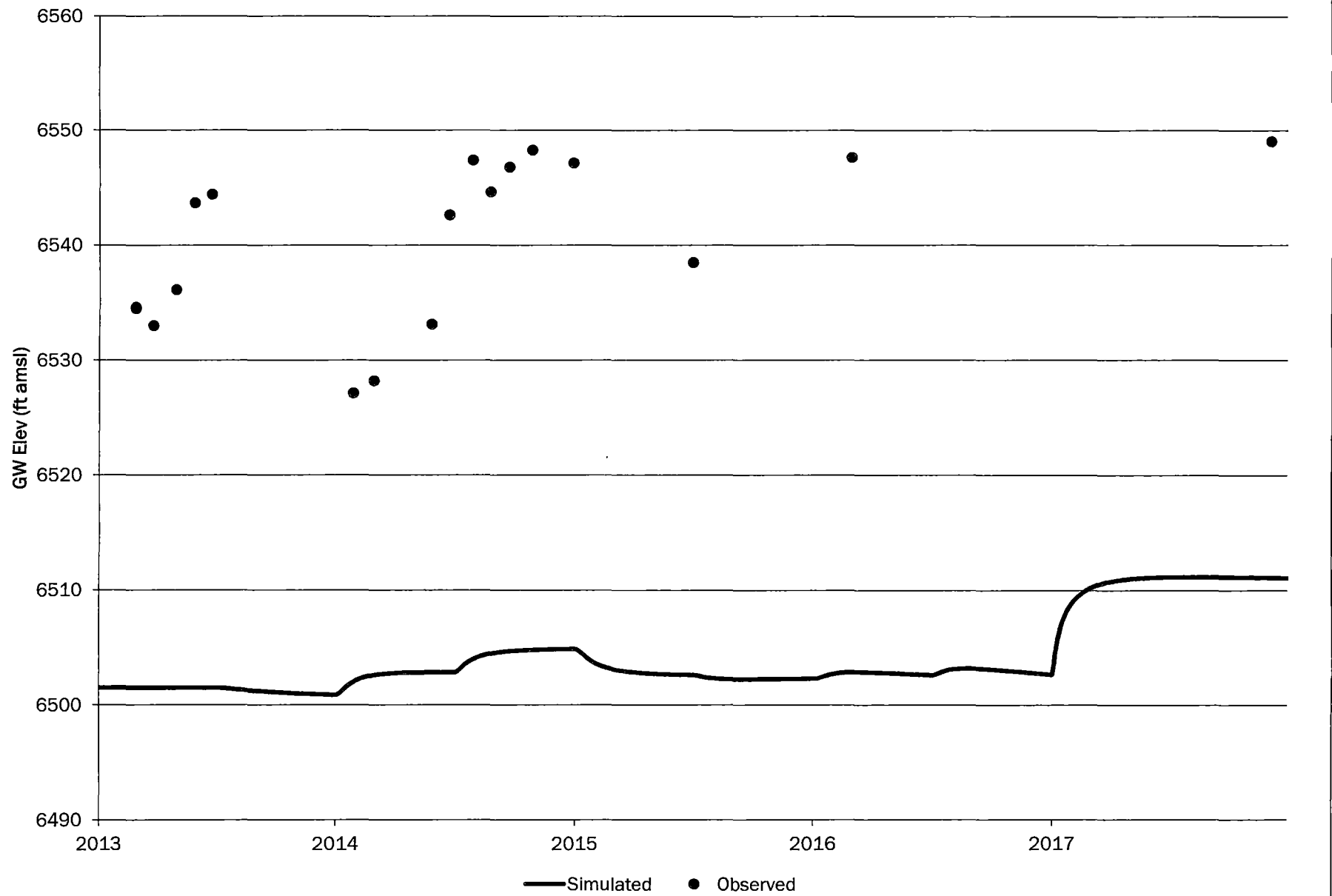
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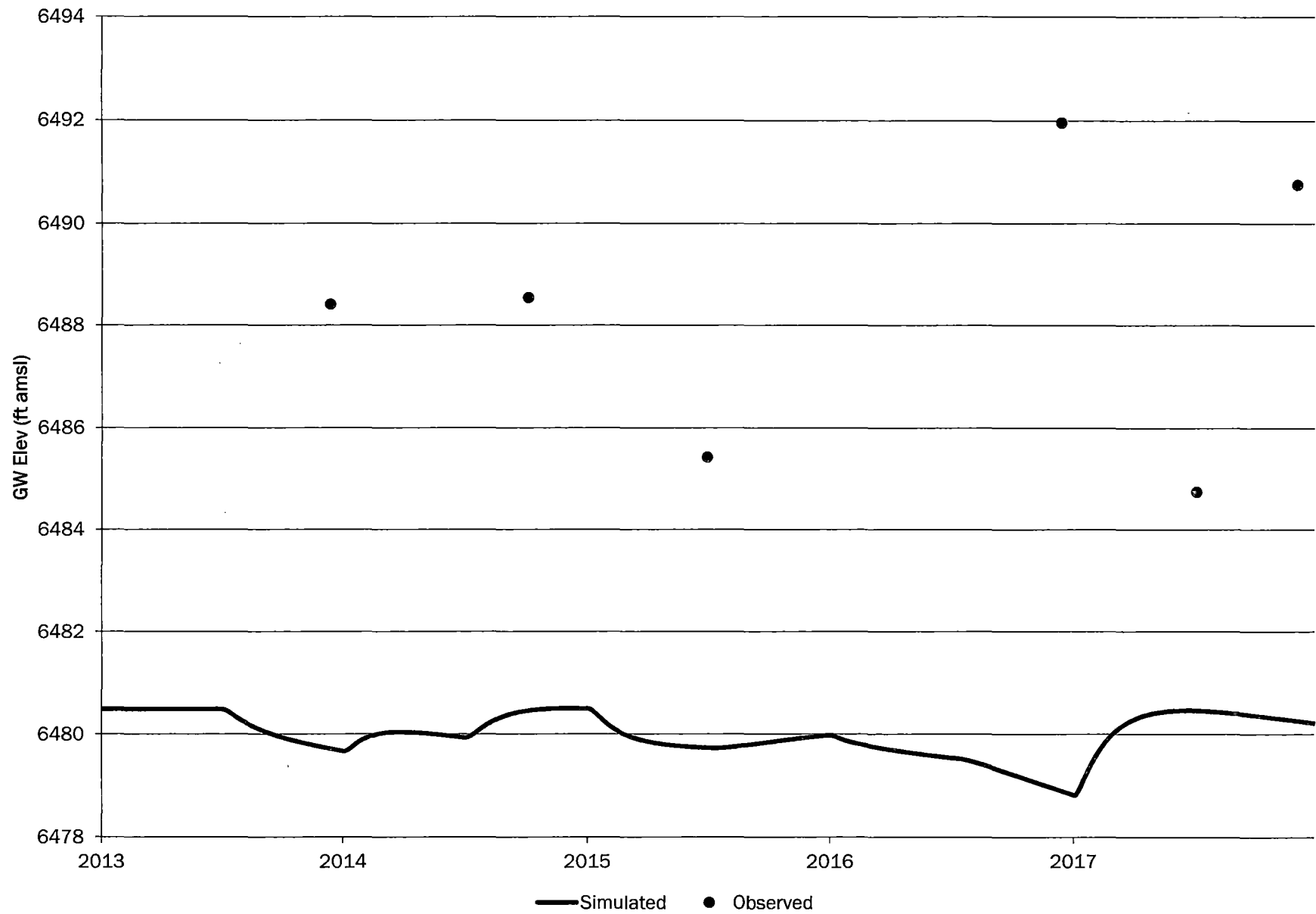
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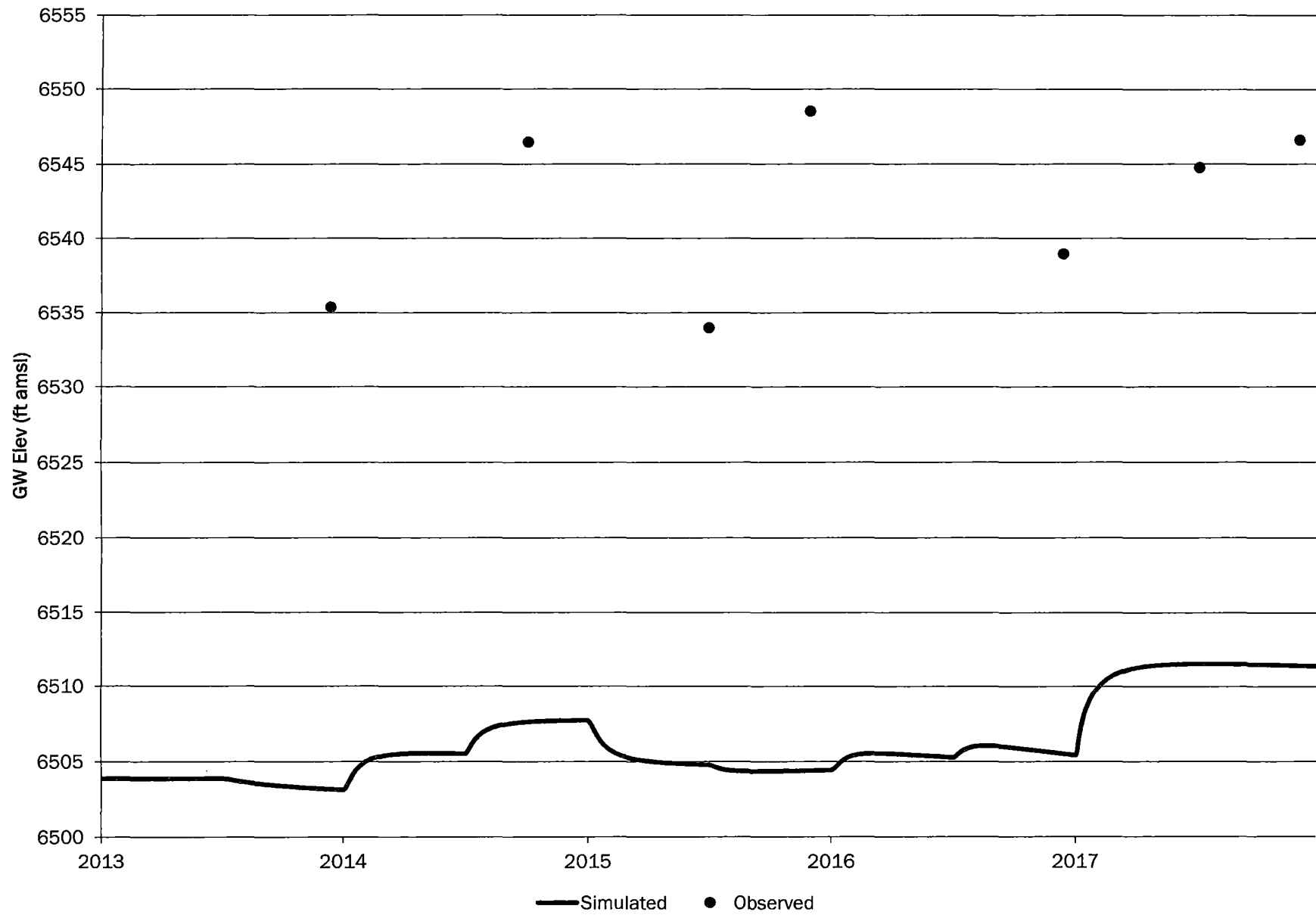
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930



931



Appendix B: Groundwater Elevation Target Dataset

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Table B-1. Groundwater Flow Model Water-Level Calibration Data

Well ID	Easting	Northing	Model Layer	Date	Model Time (days)	Measured Groundwater-Level Elevation (ft amsl)	Simulated Groundwater-Level Elevation (ft amsl)	Residual (ft)	Weight
520	492,935	1,538,934	1	12/12/2013	345	6537.53	6522.87	14.66	1.0
				12/2/2015	1065	6536.67	6541.40	-4.73	1.0
				12/13/2016	1442	6536.19	6534.83	1.36	1.0
				4/28/2017	1578	6535.50	6541.39	-5.89	1.0
				12/6/2017	1800	6534.15	6541.98	-7.83	1.0
540	488,091	1,534,125	1	5/4/2013	123	6494.00	6516.66	-22.66	1.0
				11/15/2013	318	6496.76	6514.10	-17.34	1.0
				12/13/2013	346	6496.95	6513.85	-16.90	1.0
				5/15/2015	864	6503.48	6515.39	-11.91	1.0
				12/2/2015	1065	6506.41	6517.73	-11.32	1.0
				8/5/2016	1312	6500.57	6511.53	-10.96	1.0
				12/13/2016	1442	6500.63	6508.14	-7.51	1.0
				11/7/2017	1771	6497.04	6504.66	-7.62	1.0
				12/6/2017	1800	6494.97	6504.52	-9.55	1.0
541	477,236	1,539,831	1	8/9/2013	220	6466.72	6465.18	1.54	1.0
				12/13/2013	346	6467.29	6465.18	2.11	1.0
				7/22/2015	932	6469.02	6464.51	4.51	1.0
				12/1/2015	1064	6469.66	6465.11	4.55	1.0
				12/29/2016	1458	6467.06	6464.60	2.46	1.0
				11/10/2017	1774	6465.96	6461.17	4.79	1.0
				12/6/2017	1800	6465.83	6461.00	4.83	1.0
551	479,880	1,536,272	1	2/7/2013	37	6447.69	6444.85	2.84	1.0
				8/9/2013	220	6448.10	6444.85	3.25	1.0
				12/13/2013	346	6449.50	6444.85	4.65	1.0
				2/14/2014	409	6449.70	6444.85	4.85	1.0
				8/28/2014	604	6451.10	6444.73	6.37	1.0
				2/20/2015	780	6451.65	6444.41	7.24	1.0
				12/1/2015	1064	6452.00	6444.20	7.80	1.0
				2/12/2016	1137	6453.11	6444.29	8.82	1.0
				12/13/2016	1442	6448.40	6444.67	3.73	1.0
				2/25/2017	1516	6450.12	6444.72	5.40	1.0
				3/29/2017	1548	6450.02	6444.73	5.29	1.0
				12/6/2017	1800	6449.20	6444.43	4.77	1.0
553	480,563	1,534,923	1	2/7/2013	37	6442.88	6441.50	1.38	1.0

Table B-1. Groundwater Flow Model Water-Level Calibration Data

Well ID	Easting	Northing	Model Layer	Date	Model Time (days)	Measured Groundwater-Level Elevation (ft amsl)	Simulated Groundwater-Level Elevation (ft amsl)	Residual (ft)	Weight
				8/9/2013	220	6442.88	6441.50	1.38	1.0
				12/13/2013	346	6444.03	6441.50	2.53	1.0
				2/14/2014	409	6444.14	6441.49	2.65	1.0
				8/27/2014	603	6444.00	6441.44	2.56	1.0
				2/20/2015	780	6444.97	6441.30	3.67	1.0
				12/1/2015	1064	6445.31	6441.11	4.20	1.0
				2/12/2016	1137	6446.51	6441.14	5.37	1.0
				12/13/2016	1442	6444.98	6441.59	3.39	1.0
				3/28/2017	1547	6444.84	6441.74	3.10	1.0
				12/6/2017	1800	6444.23	6441.54	2.69	1.0
554	479,107	1,534,967	1	2/7/2013	37	6440.59	6440.40	0.19	1.0
				8/9/2013	220	6440.77	6440.40	0.37	1.0
				12/13/2013	346	6442.41	6440.40	2.01	1.0
				2/14/2014	409	6442.46	6440.40	2.06	1.0
				2/20/2015	780	6443.39	6440.25	3.14	1.0
				12/1/2015	1064	6443.65	6440.10	3.55	1.0
				2/12/2016	1137	6449.19	6440.12	9.07	1.0
				12/13/2016	1442	6442.57	6440.39	2.18	1.0
				3/28/2017	1547	6442.35	6440.47	1.88	1.0
				12/6/2017	1800	6441.52	6440.43	1.09	1.0
555	486,236	1,538,572	1	2/6/2013	36	6511.20	6519.42	-8.22	1.0
				8/16/2013	227	6511.64	6519.40	-7.77	1.0
				2/12/2014	407	6512.34	6519.22	-6.88	1.0
				9/4/2014	611	6512.00	6519.23	-7.23	1.0
				2/26/2015	786	6512.06	6519.15	-7.10	1.0
				2/17/2016	1142	6513.39	6518.03	-4.64	1.0
				3/28/2017	1547	6515.31	6515.69	-0.38	1.0
556	486,184	1,538,006	1	2/6/2013	36	6500.94	6519.34	-18.40	1.0
				8/16/2013	227	6503.12	6519.32	-16.20	1.0
				9/4/2014	611	6503.86	6519.06	-15.20	1.0
				2/26/2015	786	6504.16	6519.00	-14.84	1.0
				2/11/2016	1136	6506.03	6517.98	-11.95	1.0
				3/28/2017	1547	6508.91	6515.71	-6.80	1.0
557	486,000	1,537,204	1	2/6/2013	36	6508.03	6519.12	-11.09	1.0
				8/16/2013	227	6508.07	6519.10	-11.03	1.0

Table B-1. Groundwater Flow Model Water-Level Calibration Data

Well ID	Easting	Northing	Model Layer	Date	Model Time (days)	Measured Groundwater-Level Elevation (ft amsl)	Simulated Groundwater-Level Elevation (ft amsl)	Residual (ft)	Weight
				2/12/2014	407	6508.37	6518.87	-10.50	1.0
				9/4/2014	611	6508.68	6518.75	-10.07	1.0
				2/26/2015	786	6508.72	6518.69	-9.98	1.0
				2/11/2016	1136	6509.72	6517.79	-8.07	1.0
631	483,756	1,532,234	1	3/7/2013	65	6451.40	6453.92	-2.52	1.0
				12/13/2013	346	6452.72	6453.74	-1.02	1.0
				4/2/2014	456	6453.75	6453.57	0.18	1.0
				12/3/2015	1066	6455.60	6453.65	1.95	1.0
				12/13/2016	1442	6457.40	6455.56	1.84	1.0
				12/28/2016	1457	6457.28	6455.57	1.71	1.0
				7/1/2017	1642	6454.70	6453.89	0.81	1.0
				12/6/2017	1800	6458.22	6451.95	6.27	1.0
632	483,767	1,531,850	1	3/7/2013	65	6451.80	6453.53	-1.73	1.0
				12/13/2013	346	6453.17	6453.39	-0.22	1.0
				4/2/2014	456	6454.11	6453.23	0.88	1.0
				12/3/2015	1066	6455.89	6453.25	2.64	1.0
				12/13/2016	1442	6457.56	6454.98	2.58	1.0
				7/1/2017	1642	6458.27	6453.68	4.59	1.0
				12/6/2017	1800	6460.07	6452.07	8.00	1.0
637	474,710	1,545,409	1	12/12/2014	710	6465.16	6467.47	-2.31	1.0
				12/21/2016	1450	6465.20	6467.49	-2.29	1.0
				10/7/2017	1740	6464.60	6467.06	-2.46	1.0
638	493,265	1,539,628	1	12/12/2013	345	6542.89	6528.75	14.14	1.0
				12/2/2015	1065	6543.12	6535.64	7.48	1.0
				12/13/2016	1442	6541.23	6544.37	-3.14	1.0
				4/28/2017	1578	6540.12	6543.38	-3.26	1.0
				12/6/2017	1800	6539.01	6542.98	-3.97	1.0
644	485,450	1,533,481	1	12/13/2013	346	6471.50	6472.33	-0.83	1.0
				10/11/2014	648	6473.67	6471.44	2.23	1.0
				12/2/2015	1065	6475.23	6474.01	1.22	1.0
				8/2/2016	1309	6476.16	6476.09	0.07	1.0
				12/13/2016	1442	6476.25	6475.79	0.46	1.0
				11/7/2017	1771	6475.69	6466.88	8.81	1.0
				12/6/2017	1800	6476.02	6466.53	9.49	1.0
646	484,952	1,533,246	1	12/13/2013	346	6465.79	6466.17	-0.38	1.0

Table B-1. Groundwater Flow Model Water-Level Calibration Data

Well ID	Easting	Northing	Model Layer	Date	Model Time (days)	Measured Groundwater-Level Elevation (ft amsl)	Simulated Groundwater-Level Elevation (ft amsl)	Residual (ft)	Weight
				9/4/2014	611	6468.28	6465.56	2.72	1.0
				12/3/2015	1066	6469.64	6467.27	2.37	1.0
				8/2/2016	1309	6471.31	6469.24	2.07	1.0
				12/13/2016	1442	6471.35	6469.22	2.13	1.0
				11/15/2017	1779	6471.44	6461.92	9.52	1.0
				12/6/2017	1800	6471.67	6461.65	10.02	1.0
647	478,308	1,536,623	1	2/7/2013	37	6446.91	6445.83	1.08	1.0
				8/9/2013	220	6447.51	6445.83	1.68	1.0
				12/13/2013	346	6449.19	6445.83	3.36	1.0
				8/28/2014	604	6452.96	6445.67	7.29	1.0
				2/20/2015	780	6450.93	6445.36	5.57	1.0
				12/1/2015	1064	6452.51	6445.36	7.15	1.0
				12/13/2016	1442	6448.61	6445.69	2.92	1.0
				3/16/2017	1535	6448.96	6445.69	3.27	1.0
				12/6/2017	1800	6448.08	6445.30	2.78	1.0
649	479,798	1,534,730	1	2/7/2013	37	6440.08	6440.35	-0.27	1.0
				3/7/2013	65	6440.13	6440.35	-0.22	1.0
				8/16/2013	227	6438.39	6440.35	-1.96	1.0
				12/13/2013	346	6441.58	6440.35	1.23	1.0
				2/26/2014	421	6441.46	6440.35	1.11	1.0
				4/2/2014	456	6441.19	6440.35	0.84	1.0
				12/1/2015	1064	6466.84	6440.06	26.78	1.0
				2/23/2016	1148	6442.69	6440.08	2.61	1.0
				12/13/2016	1442	6441.89	6440.39	1.50	1.0
				3/16/2017	1535	6441.73	6440.49	1.24	1.0
650	482,135	1,536,779	1	12/6/2017	1800	6441.39	6440.41	0.98	1.0
				2/7/2013	37	6463.37	6461.35	2.02	1.0
				8/16/2013	227	6463.21	6461.35	1.86	1.0
				12/12/2013	345	6463.33	6461.35	1.98	1.0
				2/26/2014	421	6463.51	6461.35	2.16	1.0
				9/4/2014	611	6459.76	6461.35	-1.59	1.0
				3/18/2015	806	6478.83	6461.34	17.49	1.0
				12/2/2015	1065	6465.61	6461.35	4.26	1.0
				2/12/2016	1137	6466.80	6461.35	5.45	1.0
				12/14/2016	1443	6465.59	6461.35	4.24	1.0

Table B-1. Groundwater Flow Model Water-Level Calibration Data

Well ID	Easting	Northing	Model Layer	Date	Model Time (days)	Measured Groundwater-Level Elevation (ft amsl)	Simulated Groundwater-Level Elevation (ft amsl)	Residual (ft)	Weight
				3/28/2017	1547	6465.73	6461.35	4.38	1.0
				12/6/2017	1800	6465.51	6461.34	4.17	1.0
654	478,636	1,541,994	1	3/7/2013	65	6479.10	6482.52	-3.42	1.0
				12/13/2013	346	6478.95	6482.52	-3.57	1.0
				6/10/2015	890	6480.15	6481.93	-1.78	1.0
				12/1/2015	1064	6481.58	6482.73	-1.15	1.0
				12/13/2016	1442	6479.05	6481.45	-2.40	1.0
				11/15/2017	1779	6477.21	6474.72	2.49	1.0
657	478,392	1,537,497	1	5/14/2013	133	6452.50	6450.13	2.37	1.0
				8/9/2013	220	6454.11	6450.13	3.98	1.0
				12/13/2013	346	6454.68	6450.13	4.55	1.0
				12/1/2015	1064	6458.91	6449.96	8.95	1.0
				12/13/2016	1442	6454.81	6450.02	4.79	1.0
				12/6/2017	1800	6452.81	6449.16	3.65	1.0
658	478,436	1,535,922	1	2/7/2013	37	6442.70	6442.73	-0.03	1.0
				10/30/2013	302	6444.53	6442.73	1.80	1.0
				12/13/2013	346	6445.25	6442.73	2.52	1.0
				2/26/2014	421	6445.18	6442.73	2.45	1.0
				8/27/2014	603	6447.40	6442.66	4.74	1.0
				2/20/2015	780	6447.03	6442.44	4.59	1.0
				12/1/2015	1064	6447.98	6442.23	5.75	1.0
				12/13/2016	1442	6445.38	6442.58	2.80	1.0
				2/22/2017	1513	6443.94	6442.63	1.31	1.0
681	482,734	1,540,676	1	12/6/2017	1800	6443.78	6442.49	1.29	1.0
				3/19/2013	77	6497.12	6509.29	-12.17	1.0
				3/27/2015	815	6498.70	6508.29	-9.59	1.0
				12/2/2015	1065	6498.69	6508.44	-9.75	1.0
				12/14/2016	1443	6497.49	6506.73	-9.24	1.0
686	475,438	1,545,319	1	12/6/2017	1800	6497.27	6503.84	-6.57	1.0
				12/12/2014	710	6467.94	6467.38	0.56	1.0
				12/21/2016	1450	6467.47	6467.72	-0.25	1.0
688	483,954	1,541,257	1	10/7/2017	1740	6466.70	6466.93	-0.23	1.0
				3/5/2013	63	6504.74	6513.24	-8.50	1.0
				10/30/2013	302	6505.79	6513.23	-7.44	1.0
				12/13/2013	346	6506.23	6513.22	-6.99	1.0

Table B-1. Groundwater Flow Model Water-Level Calibration Data

Well ID	Easting	Northing	Model Layer	Date	Model Time (days)	Measured Groundwater-Level Elevation (ft amsl)	Simulated Groundwater-Level Elevation (ft amsl)	Residual (ft)	Weight
				3/20/2014	443	6505.88	6513.13	-7.25	1.0
				3/13/2015	801	6503.56	6512.20	-8.64	1.0
				12/1/2015	1064	6505.07	6511.93	-6.86	1.0
				3/17/2016	1171	6504.60	6511.68	-7.08	1.0
				12/14/2016	1443	6504.06	6510.21	-6.15	1.0
				3/28/2017	1547	6503.75	6509.36	-5.61	1.0
				8/10/2017	1682	6503.62	6508.28	-4.66	1.0
				12/6/2017	1800	6503.37	6507.55	-4.18	1.0
690	493,465	1,540,279	1	2/20/2013	50	6546.79	6536.84	9.95	1.0
				12/12/2013	345	6546.60	6536.85	9.75	1.0
				12/2/2015	1065	6547.58	6538.17	9.41	1.0
				12/13/2016	1442	6545.44	6539.14	6.30	1.0
				4/26/2017	1576	6544.58	6539.23	5.35	1.0
				12/6/2017	1800	6543.23	6539.07	4.16	1.0
844	487,002	1,538,376	1	2/6/2013	36	6520.13	6520.64	-0.51	1.0
				8/16/2013	227	6519.83	6520.62	-0.79	1.0
				12/13/2013	346	6519.90	6520.44	-0.54	1.0
				2/26/2014	421	6519.93	6520.35	-0.42	1.0
				9/4/2014	611	6519.73	6520.41	-0.68	1.0
				2/26/2015	786	6519.85	6520.39	-0.54	1.0
				12/1/2015	1064	6519.81	6519.38	0.43	1.0
				2/20/2016	1145	6521.09	6519.16	1.93	1.0
				12/14/2016	1443	6520.29	6517.63	2.66	1.0
				3/28/2017	1547	6520.17	6516.72	3.45	1.0
845	487,833	1,537,280	1	12/6/2017	1800	6519.73	6515.18	4.55	1.0
				2/6/2013	36	6522.65	6521.78	0.87	1.0
				8/16/2013	227	6519.87	6521.71	-1.84	1.0
				12/13/2013	346	6522.93	6521.42	1.51	1.0
				2/26/2014	421	6522.90	6521.26	1.64	1.0
				9/4/2014	611	6522.57	6521.20	1.37	1.0
				2/26/2015	786	6522.94	6521.20	1.74	1.0
				12/1/2015	1064	6523.25	6520.29	2.96	1.0
				2/20/2016	1145	6523.56	6520.12	3.44	1.0
				12/14/2016	1443	6524.09	6518.62	5.47	1.0
				3/28/2017	1547	6523.60	6517.67	5.93	1.0

Table B-1. Groundwater Flow Model Water-Level Calibration Data

Well ID	Easting	Northing	Model Layer	Date	Model Time (days)	Measured Groundwater-Level Elevation (ft amsl)	Simulated Groundwater-Level Elevation (ft amsl)	Residual (ft)	Weight
				12/6/2017	1800	6522.80	6516.23	6.57	1.0
846	484,730	1,537,219	1	2/20/2013	50	6503.92	6517.95	-14.03	1.0
				10/30/2013	302	6504.12	6517.89	-13.77	1.0
				12/13/2013	346	6504.08	6517.85	-13.77	1.0
				2/26/2014	421	6504.17	6517.76	-13.59	1.0
				9/4/2014	611	6504.38	6517.63	-13.25	1.0
				3/18/2015	806	6504.47	6517.50	-13.03	1.0
				7/1/2015	911	6504.67	6517.30	-12.63	1.0
				8/20/2015	961	6505.74	6517.18	-11.44	1.0
				12/1/2015	1064	6504.84	6516.91	-12.07	1.0
				2/12/2016	1137	6505.87	6516.72	-10.85	1.0
				12/14/2016	1443	6505.08	6515.41	-10.33	1.0
				3/28/2017	1547	6505.13	6514.66	-9.53	1.0
				8/10/2017	1682	6505.12	6513.64	-8.52	1.0
				12/6/2017	1800	6505.08	6512.90	-7.82	1.0
851	483,909	1,534,692	1	12/2/2015	1065	6459.84	6461.16	-1.32	1.0
				12/14/2016	1443	6460.23	6462.92	-2.69	1.0
				12/6/2017	1800	6461.73	6459.16	2.57	1.0
852	493,989	1,535,610	1	7/1/2015	911	6519.93	6519.83	0.10	1.0
				12/2/2015	1065	6520.21	6519.67	0.54	1.0
				12/13/2016	1442	6521.13	6519.48	1.65	1.0
				12/6/2017	1800	6521.35	6519.09	2.26	1.0
855	484,184	1,532,111	1	2/20/2013	50	6452.70	6457.01	-4.31	1.0
				12/13/2013	346	6454.23	6456.75	-2.52	1.0
				12/3/2015	1066	6457.24	6456.88	0.36	1.0
				12/13/2016	1442	6459.01	6458.90	0.11	1.0
864	486,464	1,533,735	1	2/26/2013	56	6475.91	6488.54	-12.63	1.0
				8/21/2015	962	6482.67	6485.47	-2.80	1.0
				8/10/2016	1317	6482.19	6487.33	-5.14	1.0
865	488,429	1,534,123	1	10/18/2014	655	6498.05	6509.07	-11.02	1.0
				5/15/2015	864	6502.77	6514.78	-12.01	1.0
				8/21/2015	962	6504.98	6516.21	-11.23	1.0
				8/5/2016	1312	6505.03	6512.13	-7.10	1.0
867	488,409	1,533,762	1	12/13/2013	346	6495.90	6515.21	-19.31	1.0
				12/2/2015	1065	6503.60	6516.44	-12.84	1.0

Table B-1. Groundwater Flow Model Water-Level Calibration Data

Well ID	Easting	Northing	Model Layer	Date	Model Time (days)	Measured Groundwater-Level Elevation (ft amsl)	Simulated Groundwater-Level Elevation (ft amsl)	Residual (ft)	Weight
				12/13/2016	1442	6497.25	6509.35	-12.10	1.0
				12/6/2017	1800	6495.50	6506.15	-10.65	1.0
869	486,073	1,533,251	1	3/19/2013	77	6471.41	6481.47	-10.06	1.0
				6/18/2013	168	6472.36	6481.47	-9.11	1.0
				12/13/2013	346	6474.57	6480.17	-5.60	1.0
				7/19/2014	564	6477.02	6478.99	-1.97	1.0
				8/21/2015	962	6479.31	6481.43	-2.12	1.0
				12/2/2015	1065	6479.16	6482.49	-3.33	1.0
				12/13/2016	1442	6479.89	6483.65	-3.76	1.0
				11/4/2017	1768	6479.05	6472.88	6.17	1.0
				12/6/2017	1800	6479.15	6472.56	6.59	1.0
876	486,088	1,532,853	1	12/13/2013	346	6474.32	6477.29	-2.97	1.0
				12/2/2015	1065	6479.19	6479.98	-0.79	1.0
				12/13/2016	1442	6480.06	6481.34	-1.28	1.0
				12/6/2017	1800	6479.92	6469.62	10.30	1.0
881	481,478	1,542,034	1	2/9/2013	39	6493.38	6503.61	-10.23	1.0
				12/13/2013	346	6494.41	6503.61	-9.20	1.0
				2/12/2014	407	6494.68	6503.07	-8.39	1.0
				8/27/2014	603	6494.74	6502.22	-7.48	1.0
				2/27/2015	787	6496.38	6502.40	-6.02	1.0
				2/19/2016	1144	6496.81	6503.11	-6.30	1.0
				12/13/2016	1442	6493.86	6500.99	-7.13	1.0
				2/24/2017	1515	6493.57	6500.33	-6.76	1.0
882	482,396	1,541,404	1	2/12/2013	42	6498.08	6507.94	-9.86	1.0
				8/9/2013	220	6497.36	6507.94	-10.58	1.0
				2/12/2014	407	6499.69	6507.71	-8.02	1.0
				8/27/2014	603	6498.52	6506.96	-8.44	1.0
				2/27/2015	787	6499.79	6506.76	-6.97	1.0
				2/19/2016	1144	6499.86	6507.00	-7.14	1.0
				3/16/2017	1535	6497.26	6504.48	-7.22	1.0
884	481,498	1,542,677	1	2/9/2013	39	6495.75	6504.15	-8.40	1.0
				8/9/2013	220	6494.60	6504.15	-9.55	1.0
				2/12/2014	407	6496.10	6503.73	-7.63	1.0
				8/6/2014	582	6496.66	6502.85	-6.19	1.0
				2/27/2015	787	6498.51	6502.83	-4.32	1.0

Table B-1. Groundwater Flow Model Water-Level Calibration Data

Well ID	Easting	Northing	Model Layer	Date	Model Time (days)	Measured Groundwater-Level Elevation (ft amsl)	Simulated Groundwater-Level Elevation (ft amsl)	Residual (ft)	Weight
				2/19/2016	1144	6497.84	6503.50	-5.66	1.0
				3/28/2017	1547	6495.08	6500.57	-5.49	1.0
885	483,474	1,541,919	1	3/20/2013	78	6502.83	6512.26	-9.43	1.0
				8/9/2013	220	6501.14	6512.26	-11.12	1.0
				12/13/2013	346	6504.70	6512.25	-7.55	1.0
				10/23/2014	660	6501.83	6511.32	-9.49	1.0
				12/1/2015	1064	6503.33	6510.92	-7.59	1.0
				12/13/2016	1442	6500.84	6509.21	-8.37	1.0
				3/30/2017	1549	6500.44	6508.30	-7.86	1.0
				10/5/2017	1738	6500.64	6506.86	-6.22	1.0
				12/6/2017	1800	6499.94	6506.49	-6.55	1.0
886	482,487	1,542,327	1	2/9/2013	39	6498.08	6508.83	-10.75	1.0
				11/16/2013	319	6508.98	6508.83	0.15	1.0
				12/13/2013	346	6500.07	6508.82	-8.75	1.0
				8/27/2014	603	6498.78	6507.93	-9.15	1.0
				10/17/2014	654	6498.70	6507.73	-9.03	1.0
				12/1/2015	1064	6500.32	6507.85	-7.53	1.0
				2/19/2016	1144	6500.05	6507.70	-7.65	1.0
				12/13/2016	1442	6497.15	6506.05	-8.90	1.0
				3/4/2017	1523	6496.83	6505.17	-8.34	1.0
				11/7/2017	1771	6497.01	6503.16	-6.15	1.0
888	479,335	1,542,285	1	11/10/2017	1774	6496.85	6503.15	-6.30	1.0
				3/20/2013	78	6482.97	6489.01	-6.04	1.0
				8/9/2013	220	6493.83	6489.01	4.82	1.0
				12/13/2013	346	6482.90	6489.01	-6.11	1.0
				3/25/2015	813	6483.68	6486.95	-3.27	1.0
				12/1/2015	1064	6485.66	6488.58	-2.92	1.0
				2/10/2016	1135	6485.09	6488.94	-3.85	1.0
				12/13/2016	1442	6482.90	6487.27	-4.37	1.0
				3/29/2017	1548	6483.31	6483.42	-0.11	1.0
893	482,244	1,541,934	1	10/7/2017	1740	6482.03	6481.06	0.97	1.0
				12/6/2017	1800	6481.13	6480.59	0.54	1.0
				2/12/2013	42	6497.49	6507.39	-9.90	1.0
				8/9/2013	220	6496.72	6507.39	-10.67	1.0
				12/13/2013	346	6498.89	6507.38	-8.49	1.0

Table B-1. Groundwater Flow Model Water-Level Calibration Data

Well ID	Easting	Northing	Model Layer	Date	Model Time (days)	Measured Groundwater-Level Elevation (ft amsl)	Simulated Groundwater-Level Elevation (ft amsl)	Residual (ft)	Weight
				2/12/2014	407	6496.09	6507.13	-11.04	1.0
				8/27/2014	603	6497.43	6506.37	-8.94	1.0
				3/13/2015	801	6496.75	6506.25	-9.50	1.0
				12/1/2015	1064	6499.04	6506.61	-7.57	1.0
				2/20/2016	1145	6498.96	6506.46	-7.50	1.0
				12/13/2016	1442	6496.39	6504.72	-8.33	1.0
				3/15/2017	1534	6496.45	6503.70	-7.25	1.0
				12/6/2017	1800	6500.27	6501.56	-1.29	1.0
920	496,900	1,555,800	1	10/7/2016	1375	6620.62	6559.08	61.54	1.0
853_A	484,824	1,532,124	1	12/12/2013	345	6465.63	6464.22	1.41	1.0
				6/19/2014	534	6467.65	6463.98	3.67	1.0
				7/2/2015	912	6468.75	6464.01	4.74	1.0
				12/2/2015	1065	6469.07	6464.81	4.26	1.0
				12/13/2016	1442	6470.70	6466.29	4.41	1.0
				7/7/2017	1648	6471.68	6463.15	8.53	1.0
				12/6/2017	1800	6471.16	6461.55	9.61	1.0
494	489,494	1,536,689	4	2/9/2013	39	6526.93	6523.82	3.11	1.0
				7/9/2013	189	6526.58	6523.17	3.41	1.0
				12/12/2013	345	6526.14	6521.98	4.16	1.0
				2/13/2014	408	6525.24	6522.03	3.21	1.0
				6/17/2014	532	6523.82	6521.43	2.39	1.0
				3/5/2015	793	6527.84	6520.74	7.10	1.0
				12/2/2015	1065	6529.84	6520.62	9.22	1.0
				2/16/2016	1141	6530.17	6520.85	9.32	1.0
				7/13/2016	1289	6529.28	6520.35	8.93	1.0
				12/14/2016	1443	6528.78	6518.75	10.03	1.0
				3/2/2017	1521	6528.24	6517.88	10.36	1.0
				6/29/2017	1640	6526.24	6517.33	8.91	1.0
929	495,585	1,544,684	4	2/26/2013	56	6534.60	6501.51	33.09	1.0
				2/26/2013	56	6534.47	6501.51	32.96	1.0
				3/26/2013	84	6532.99	6501.51	31.48	1.0
				4/30/2013	119	6536.12	6501.51	34.61	1.0
				5/29/2013	148	6543.65	6501.51	42.14	1.0
				6/25/2013	175	6544.39	6501.51	42.88	1.0
				1/28/2014	392	6527.13	6501.98	25.15	1.0

Table B-1. Groundwater Flow Model Water-Level Calibration Data

Well ID	Easting	Northing	Model Layer	Date	Model Time (days)	Measured Groundwater-Level Elevation (ft amsl)	Simulated Groundwater-Level Elevation (ft amsl)	Residual (ft)	Weight
				3/1/2014	424	6528.22	6502.59	25.63	1.0
				5/28/2014	512	6533.11	6502.84	30.27	1.0
				6/24/2014	539	6542.61	6502.84	39.77	1.0
				7/29/2014	574	6547.37	6503.98	43.39	1.0
				8/26/2014	602	6544.63	6504.48	40.15	1.0
				9/23/2014	630	6546.79	6504.69	42.10	1.0
				10/28/2014	665	6548.27	6504.81	43.46	1.0
				12/30/2014	728	6547.13	6504.88	42.25	1.0
				7/2/2015	912	6538.48	6502.62	35.86	1.0
				3/1/2016	1155	6547.62	6502.87	44.75	1.0
				12/6/2017	1800	6549.06	6511.08	37.98	1.0
931	495,207	1,542,461	4	12/12/2013	345	6535.36	6503.18	32.18	1.0
				10/3/2014	640	6546.45	6507.63	38.82	1.0
				7/2/2015	912	6533.98	6504.79	29.19	1.0
				12/1/2015	1064	6548.51	6504.41	44.10	1.0
				12/13/2016	1442	6538.97	6505.52	33.45	1.0
				7/6/2017	1647	6544.76	6511.55	33.21	1.0
				12/6/2017	1800	6546.59	6511.44	35.15	1.0
493	489,492	1,536,702	6	2/9/2013	39	6470.92	6506.99	-36.07	1.0
				7/9/2013	189	6492.86	6503.84	-10.98	1.0
				12/12/2013	345	6491.88	6501.78	-9.90	1.0
				2/13/2014	408	6491.28	6504.64	-13.36	1.0
				6/17/2014	532	6489.95	6503.44	-13.49	1.0
				10/16/2014	653	6479.55	6502.81	-23.26	1.0
				10/18/2014	655	6478.87	6502.80	-23.93	1.0
				11/6/2014	674	6476.33	6502.71	-26.38	1.0
				11/14/2014	682	6476.69	6502.68	-25.99	1.0
				12/2/2014	700	6475.99	6502.60	-26.61	1.0
				3/5/2015	793	6490.72	6502.16	-11.44	1.0
				12/2/2015	1065	6493.16	6504.91	-11.75	1.0
				2/16/2016	1141	6492.23	6503.71	-11.48	1.0
				7/12/2016	1288	6496.34	6501.46	-5.12	1.0
				12/14/2016	1443	6489.50	6498.45	-8.95	1.0
				3/2/2017	1521	6491.85	6498.67	-6.82	1.0
				12/6/2017	1800	6478.78	6497.51	-18.73	1.0

Table B-1. Groundwater Flow Model Water-Level Calibration Data

Well ID	Easting	Northing	Model Layer	Date	Model Time (days)	Measured Groundwater-Level Elevation (ft amsl)	Simulated Groundwater-Level Elevation (ft amsl)	Residual (ft)	Weight
859	487,426	1,534,549	6	11/20/2013	323	6494.12	6508.01	-13.89	1.0
				12/12/2013	345	6494.26	6507.84	-13.58	1.0
				6/19/2014	534	6491.91	6503.77	-11.86	1.0
				10/8/2014	645	6491.36	6501.99	-10.63	1.0
				10/10/2014	647	6491.17	6501.97	-10.80	1.0
				10/14/2014	651	6490.60	6501.93	-11.33	1.0
				10/16/2014	653	6490.22	6501.92	-11.70	1.0
				10/18/2014	655	6489.81	6501.90	-12.09	1.0
				11/6/2014	674	6487.43	6501.74	-14.31	1.0
				11/14/2014	682	6487.27	6501.68	-14.41	1.0
				12/2/2014	700	6486.78	6501.54	-14.76	1.0
				12/2/2015	1065	6496.91	6509.49	-12.58	1.0
				12/13/2016	1442	6490.32	6501.07	-10.75	1.0
				12/6/2017	1800	6489.63	6498.42	-8.79	1.0
930	494,997	1,542,848	6	12/12/2013	345	6488.41	6479.72	8.69	1.0
				10/4/2014	641	6488.54	6480.46	8.08	1.0
				7/1/2015	911	6485.43	6479.73	5.70	1.0
				12/13/2016	1442	6491.96	6478.90	13.06	1.0
				7/6/2017	1647	6484.74	6480.46	4.28	1.0
				12/6/2017	1800	6490.76	6480.26	10.50	1.0
853_LC	484,824	1,532,124	8	12/12/2013	345	6465.63	6464.56	1.07	1.0
				6/19/2014	534	6467.65	6464.30	3.35	1.0
				7/2/2015	912	6468.75	6464.40	4.35	1.0
				12/2/2015	1065	6469.07	6465.28	3.79	1.0
				12/13/2016	1442	6470.70	6466.85	3.85	1.0
				7/7/2017	1648	6471.68	6463.26	8.42	1.0
				12/6/2017	1800	6471.16	6461.52	9.64	1.0
11.10.08.344	475,185	1,524,399	10	5/9/2016	1224	6438.00	6433.45	4.55	1.0
11.10.09.221	482,873	1,529,418	10	4/2/2013	91	6422.00	6431.63	-9.63	1.0
				5/6/2016	1221	6422.00	6431.68	-9.68	1.0
				6/13/2017	1624	6419.00	6431.82	-12.82	1.0
				12/14/2017	1808	6420.00	6431.84	-11.84	1.0
11.10.27.241	487,858	1,512,323	10	4/2/2013	91	6417.00	6414.44	2.56	1.0
				8/15/2013	226	6415.00	6414.44	0.56	1.0
				3/21/2014	444	6416.00	6414.44	1.56	1.0

Table B-1. Groundwater Flow Model Water-Level Calibration Data

Well ID	Easting	Northing	Model Layer	Date	Model Time (days)	Measured Groundwater-Level Elevation (ft amsl)	Simulated Groundwater-Level Elevation (ft amsl)	Residual (ft)	Weight
				8/8/2014	584	6414.00	6414.44	-0.44	1.0
				2/26/2015	786	6416.00	6414.45	1.55	1.0
				7/22/2015	932	6414.00	6414.45	-0.45	1.0
				3/14/2016	1168	6416.00	6414.45	1.55	1.0
				5/23/2016	1238	6415.00	6414.45	0.55	1.0
				7/27/2016	1303	6413.00	6414.45	-1.45	1.0
				8/8/2016	1315	6413.00	6414.45	-1.45	1.0
				8/16/2016	1323	6413.00	6414.46	-1.46	1.0
				12/12/2016	1441	6415.00	6414.47	0.53	1.0
				4/7/2017	1557	6415.00	6414.49	0.51	1.0
				4/11/2017	1561	6414.00	6414.49	-0.49	1.0
				10/5/2017	1738	6413.00	6414.52	-1.52	1.0
				12/11/2017	1805	6415.00	6414.53	0.47	1.0
12.10.20.333A	473,212	1,545,470	10	4/2/2013	91	6432.00	6454.58	-22.58	1.0
				2/2/2016	1127	6431.00	6454.66	-23.66	1.0
				3/16/2016	1170	6430.00	6454.68	-24.68	1.0
				5/26/2016	1241	6429.00	6454.70	-25.70	1.0
				5/25/2017	1605	6430.00	6454.83	-24.83	1.0
				11/6/2017	1770	6429.00	6454.84	-25.84	1.0
				12/14/2017	1808	6430.00	6454.84	-24.84	1.0
12.10.23.233	491,790	1,548,181	10	4/3/2013	92	6463.00	6451.96	11.04	1.0
				8/15/2013	226	6465.00	6451.96	13.04	1.0
				3/21/2014	444	6479.00	6452.00	27.00	1.0
				8/8/2014	584	6466.00	6452.02	13.98	1.0
				2/26/2015	786	6474.00	6452.03	21.97	1.0
				7/22/2015	932	6481.00	6452.02	28.98	1.0
				3/17/2016	1171	6461.00	6452.08	8.92	1.0
12.10.32.111	473,116	1,539,606	10	3/18/2016	1172	6415.00	6445.89	-30.89	1.0
12.10.34.412	487,224	1,537,264	10	4/2/2013	91	6416.00	6428.82	-12.82	0.5
				3/17/2016	1171	6429.00	6431.31	-2.31	1.0
				6/2/2016	1248	6430.00	6431.47	-1.47	1.0
				6/13/2017	1624	6421.00	6431.87	-10.87	1.0
				12/13/2017	1807	6423.00	6431.94	-8.94	1.0
12.11.09.114A	447,774	1,559,953	10	5/3/2016	1218	6470.00	6513.67	-43.67	1.0
				6/15/2017	1626	6512.00	6513.69	-1.69	1.0

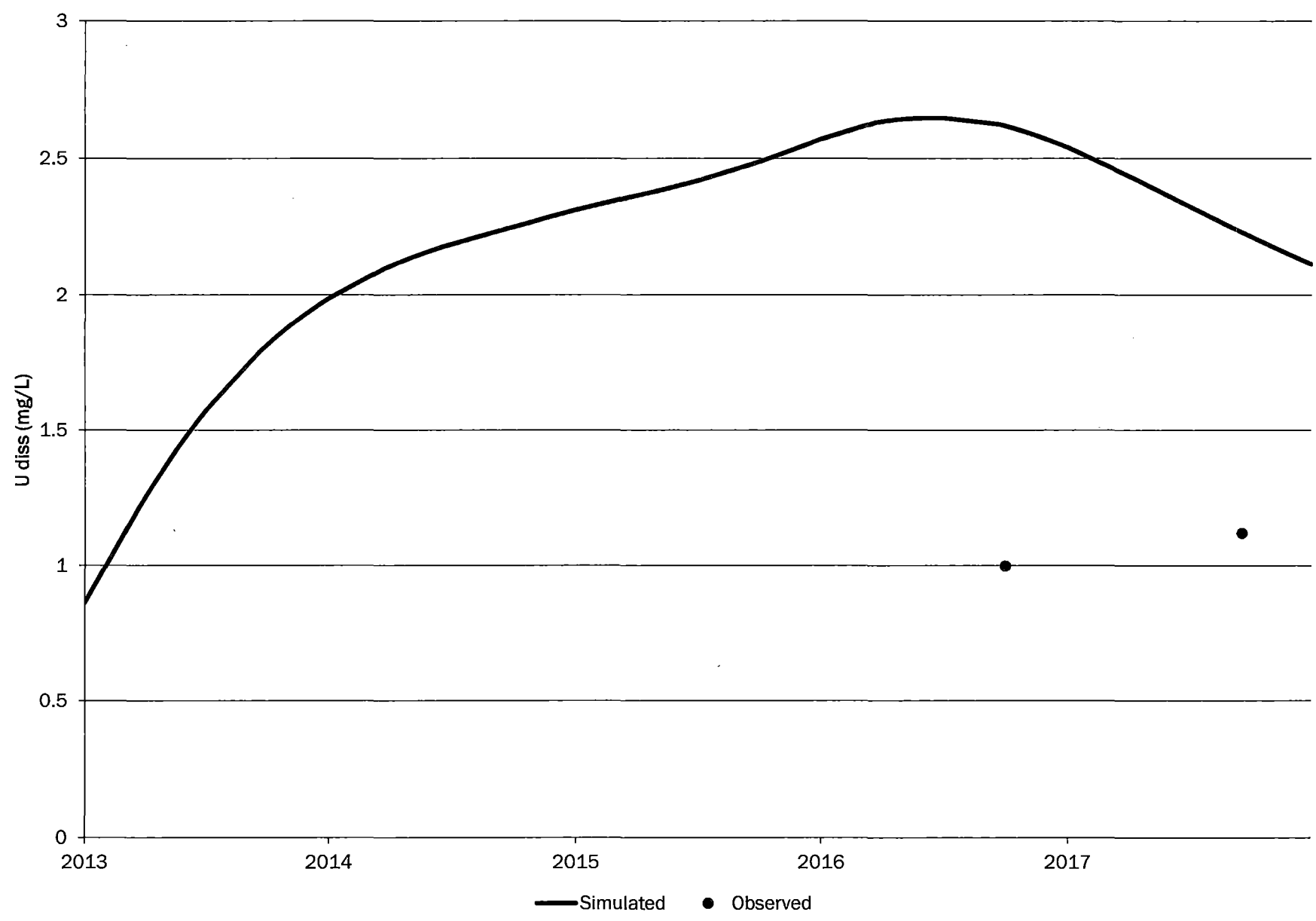
Table B-1. Groundwater Flow Model Water-Level Calibration Data

Well ID	Easting	Northing	Model Layer	Date	Model Time (days)	Measured Groundwater-Level Elevation (ft amsl)	Simulated Groundwater-Level Elevation (ft amsl)	Residual (ft)	Weight
12.11.15.341	453,979	1,551,754	10	11/3/2017	1767	6464.00	6488.59	-24.59	1.0
12.11.25.313	462,782	1,541,821	10	4/3/2013	92	6436.00	6462.30	-26.30	1.0

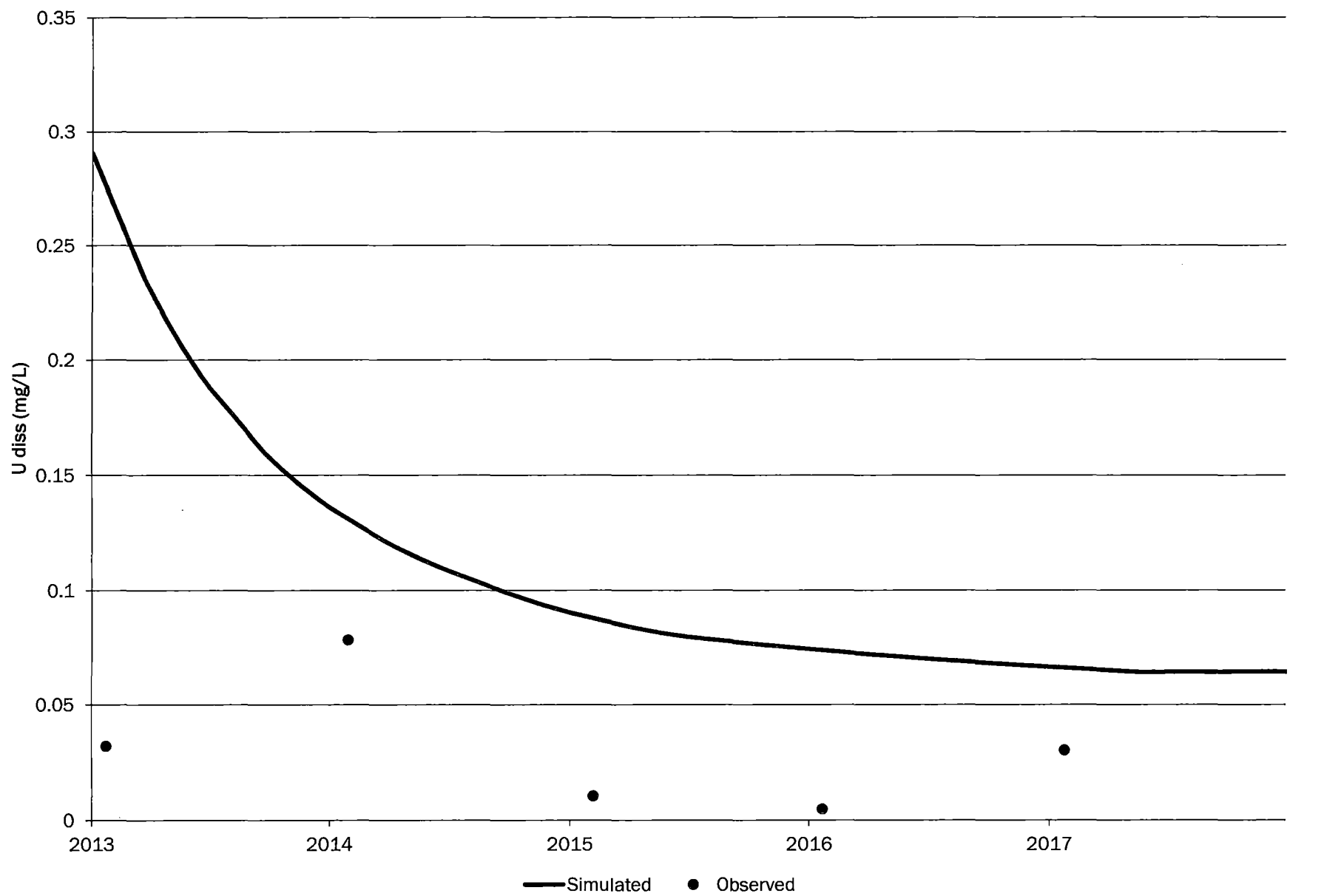
Appendix C: Simulated Constituent Chemographs

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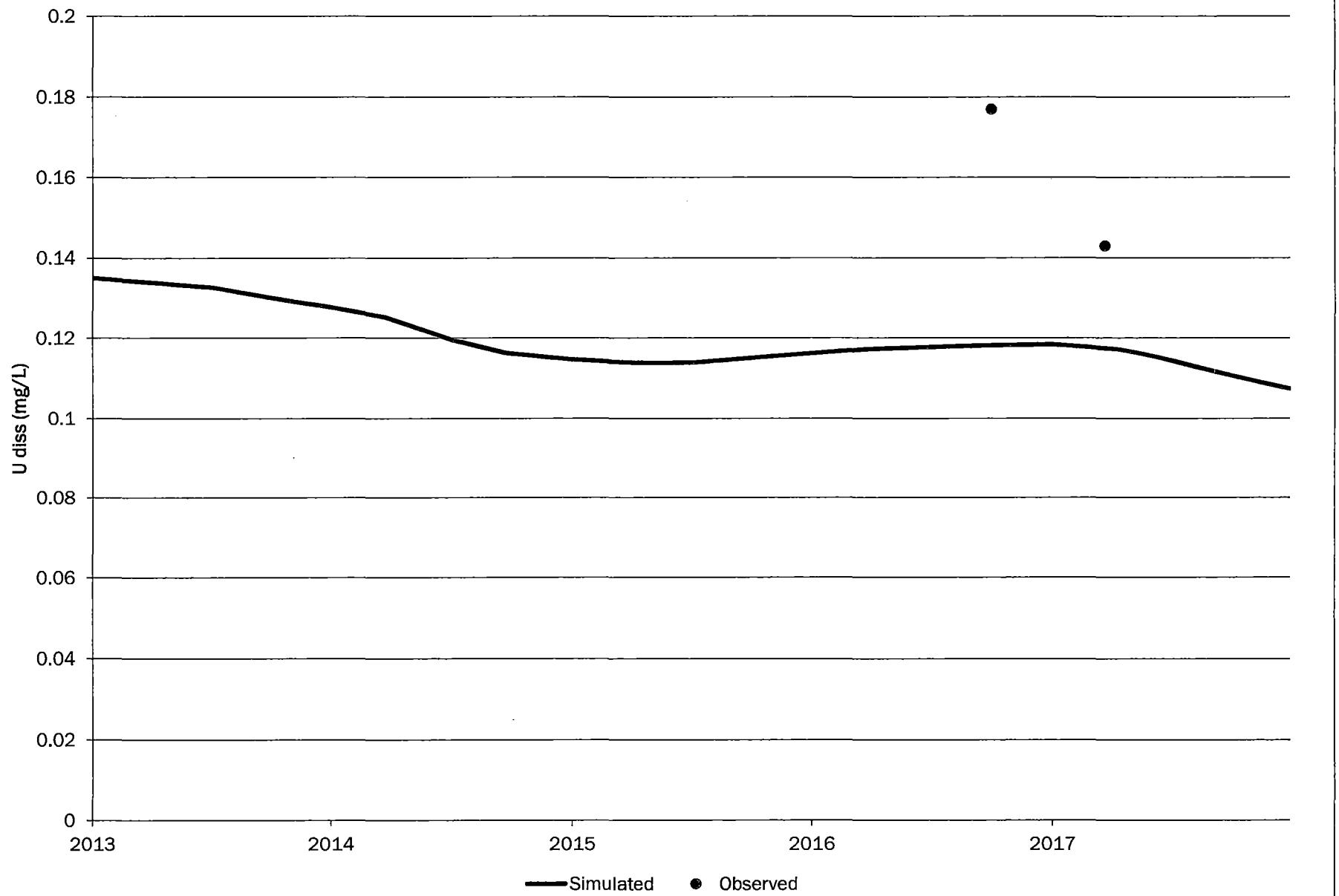
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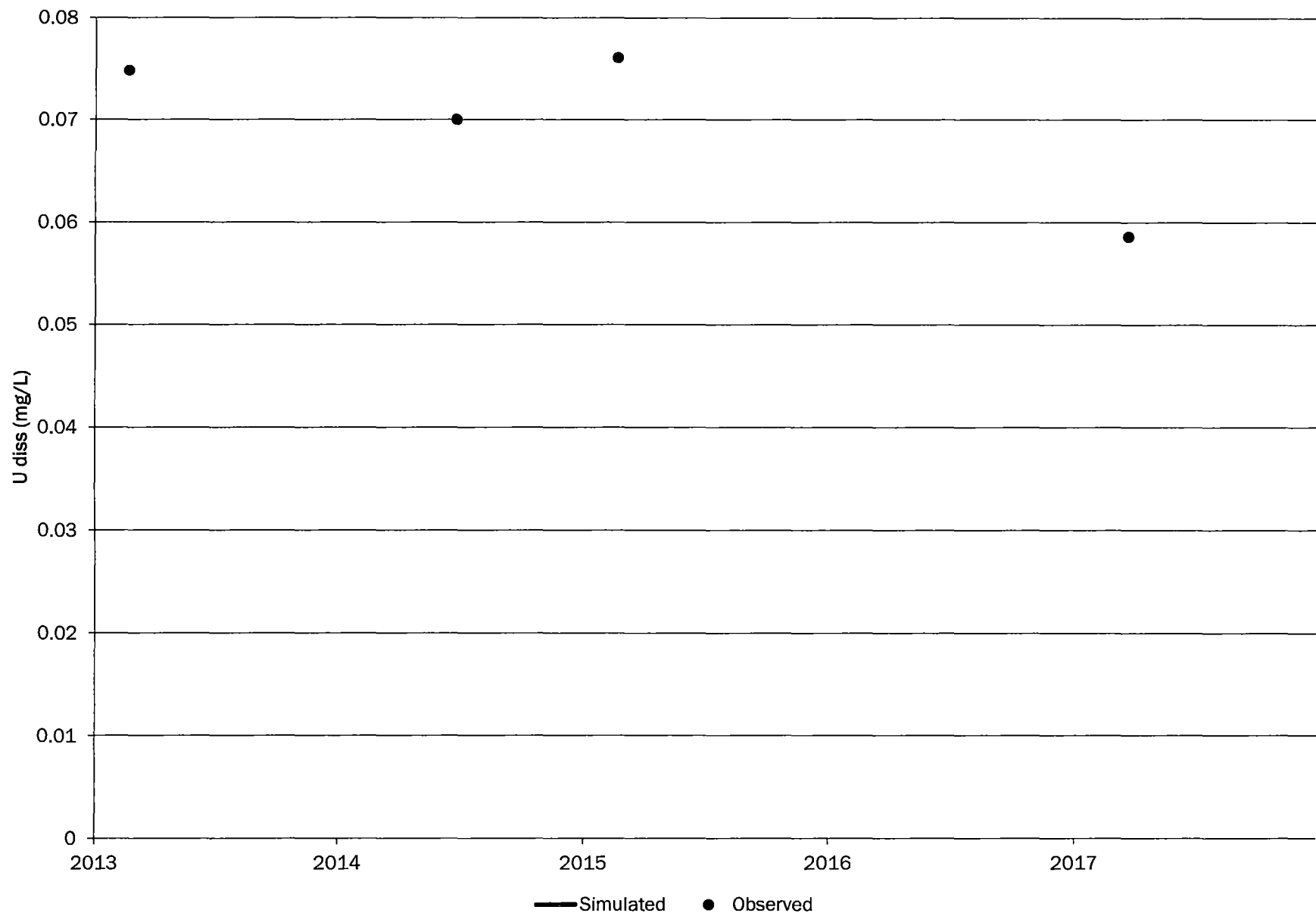
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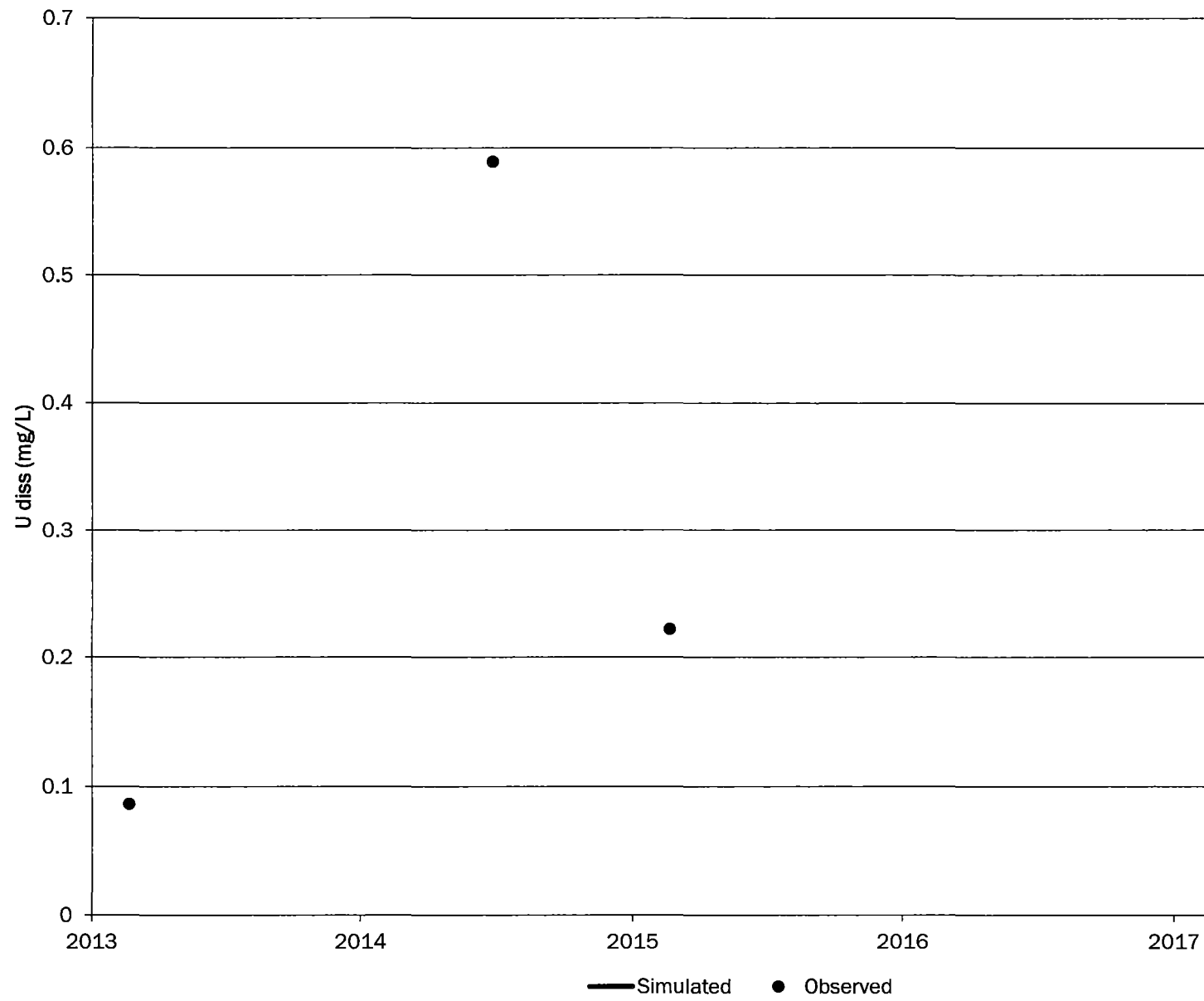
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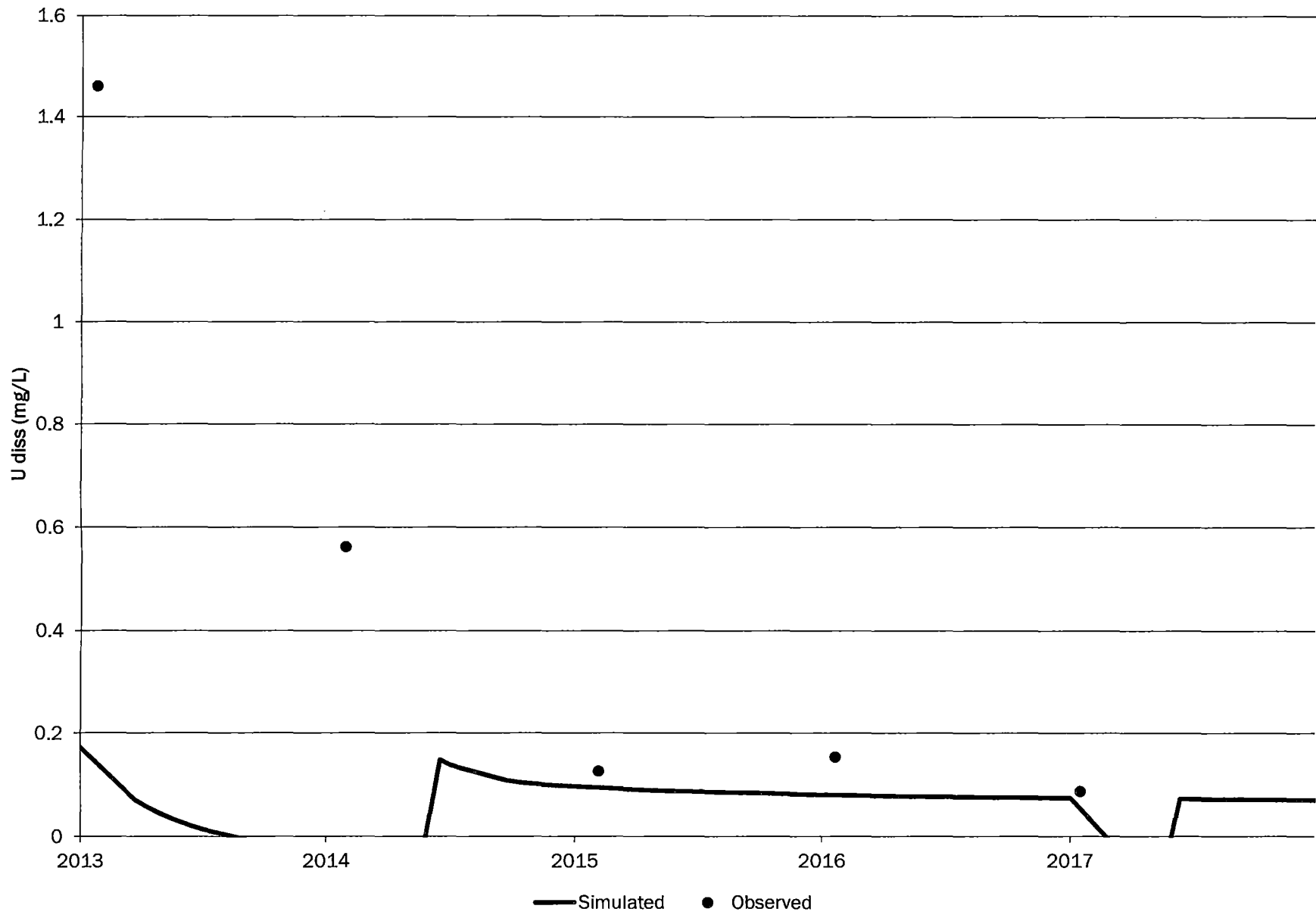
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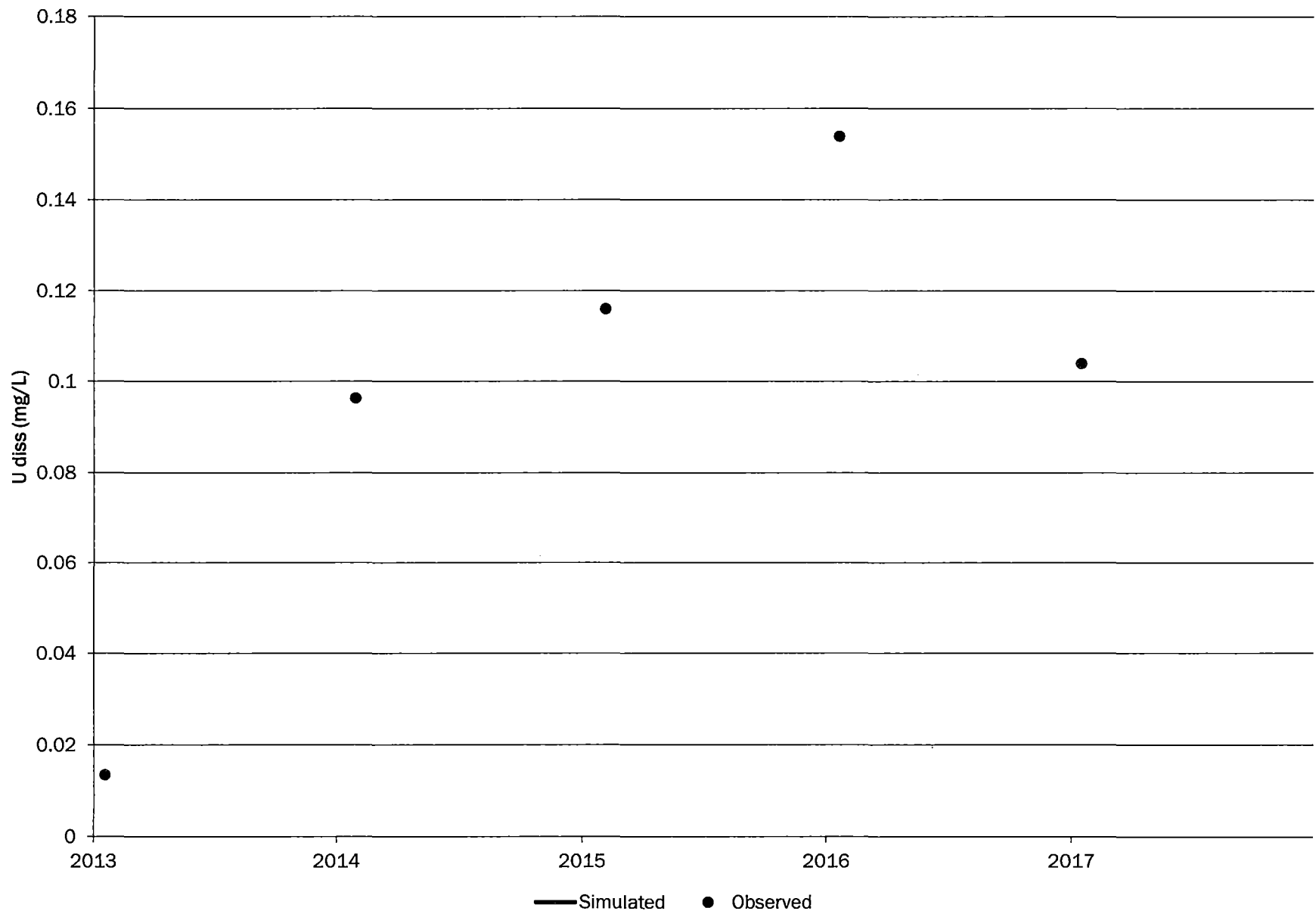
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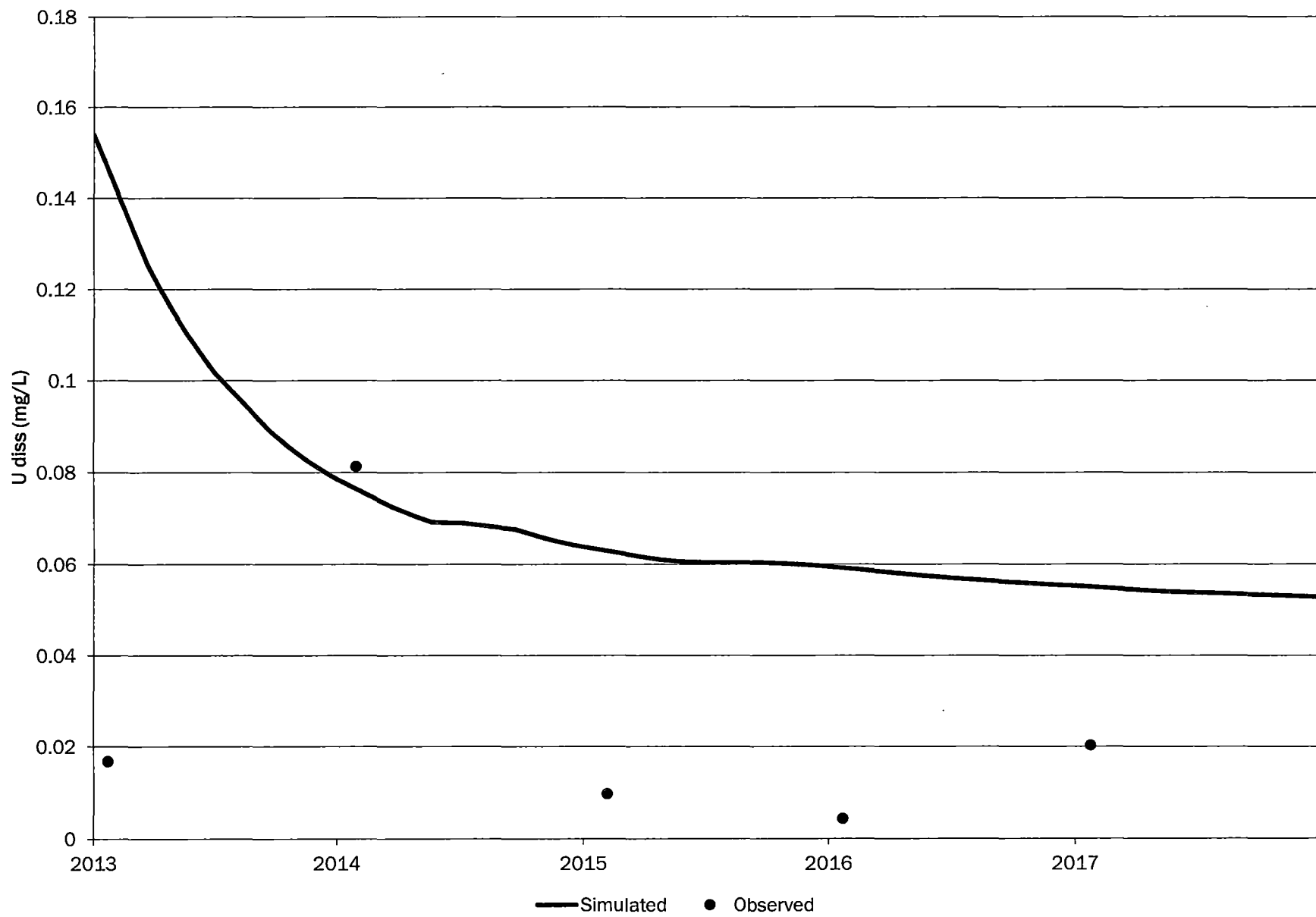
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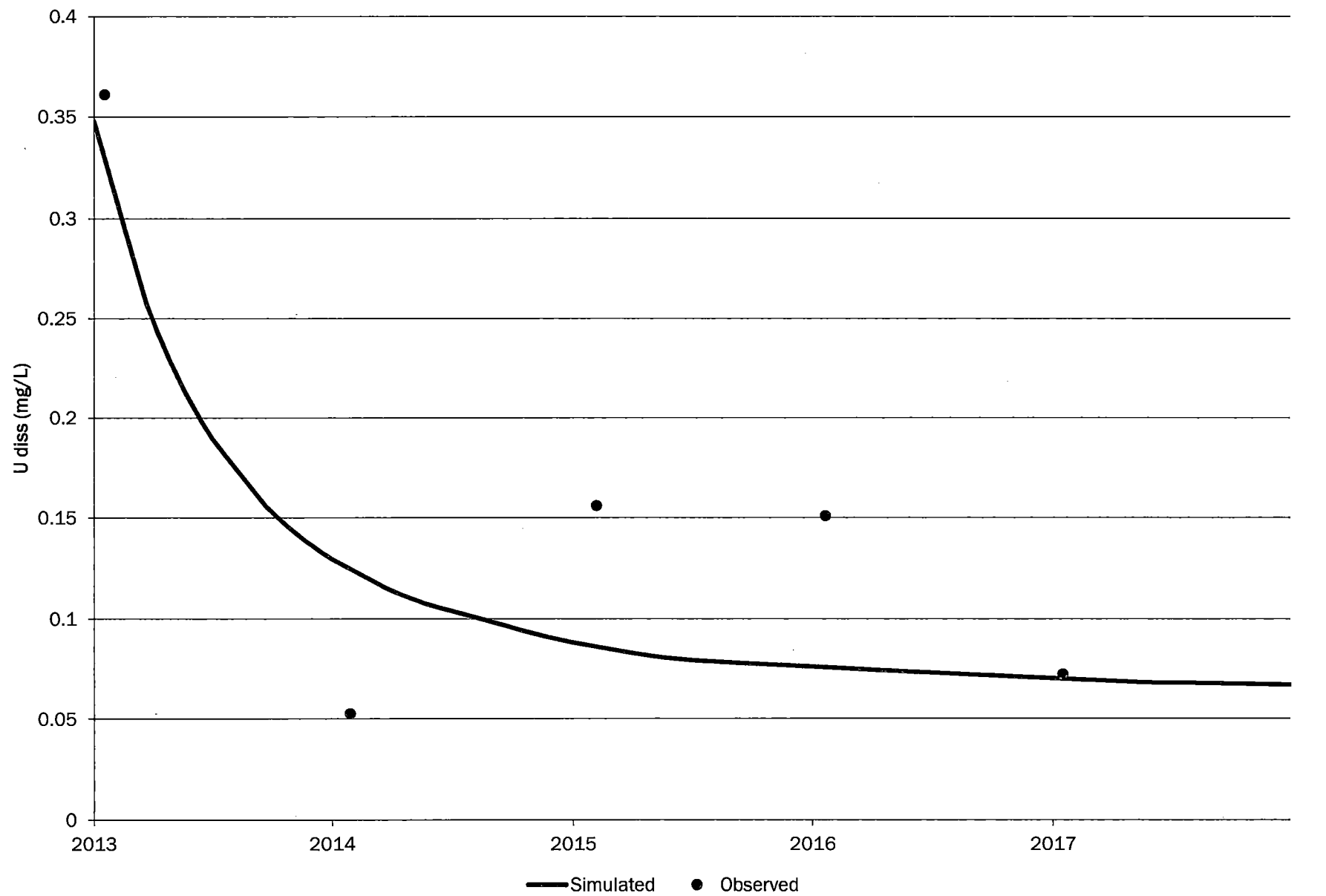
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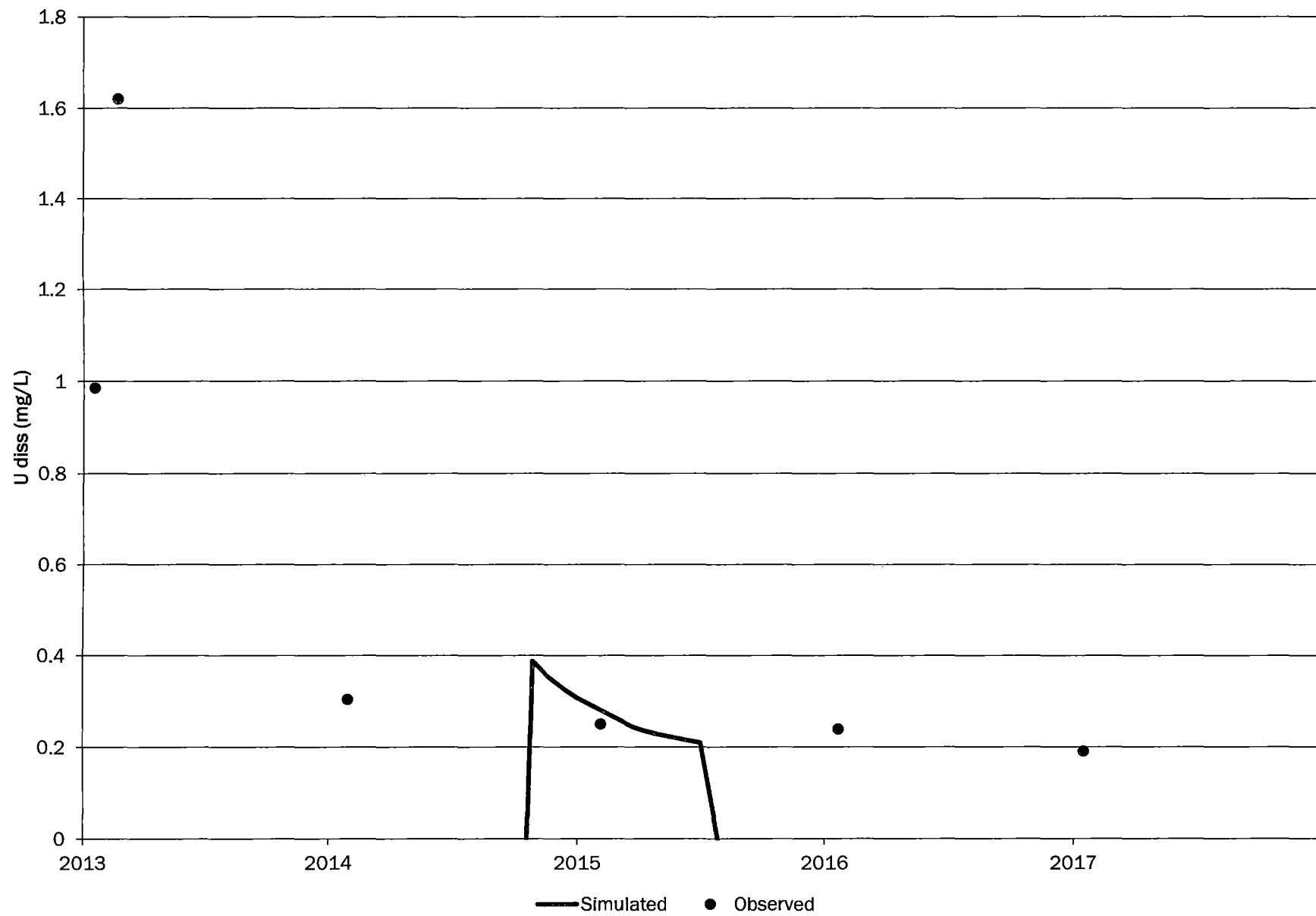
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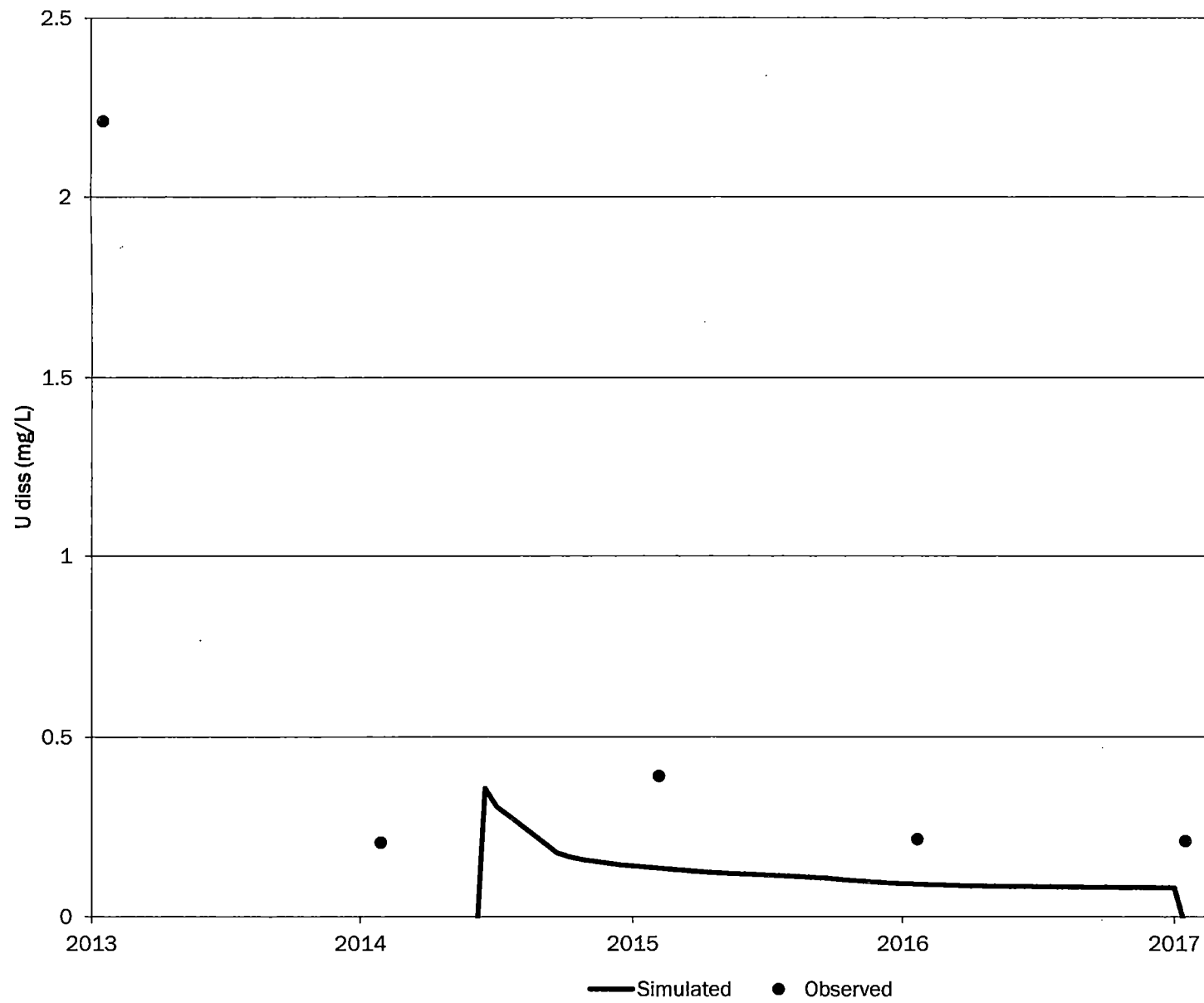
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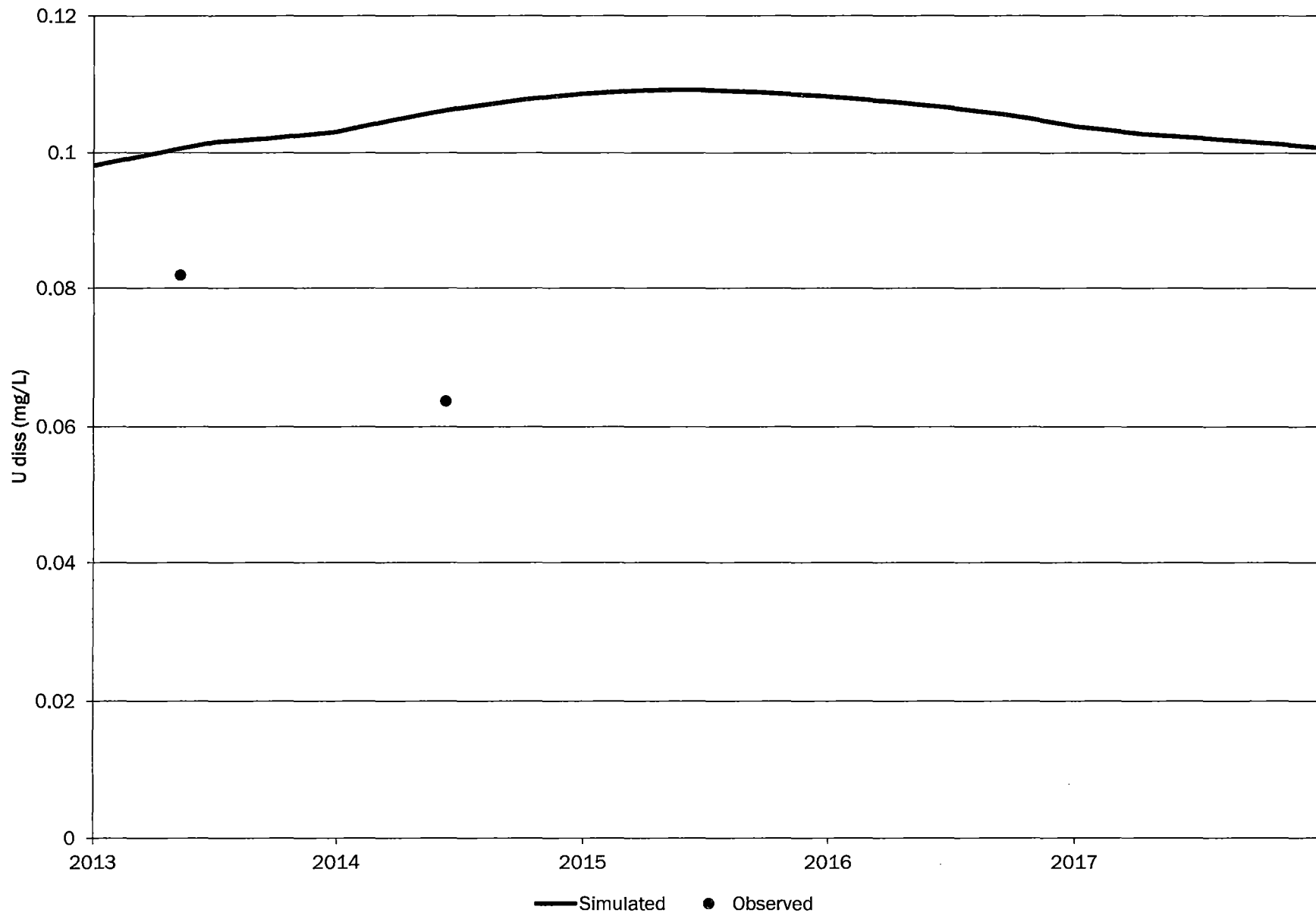
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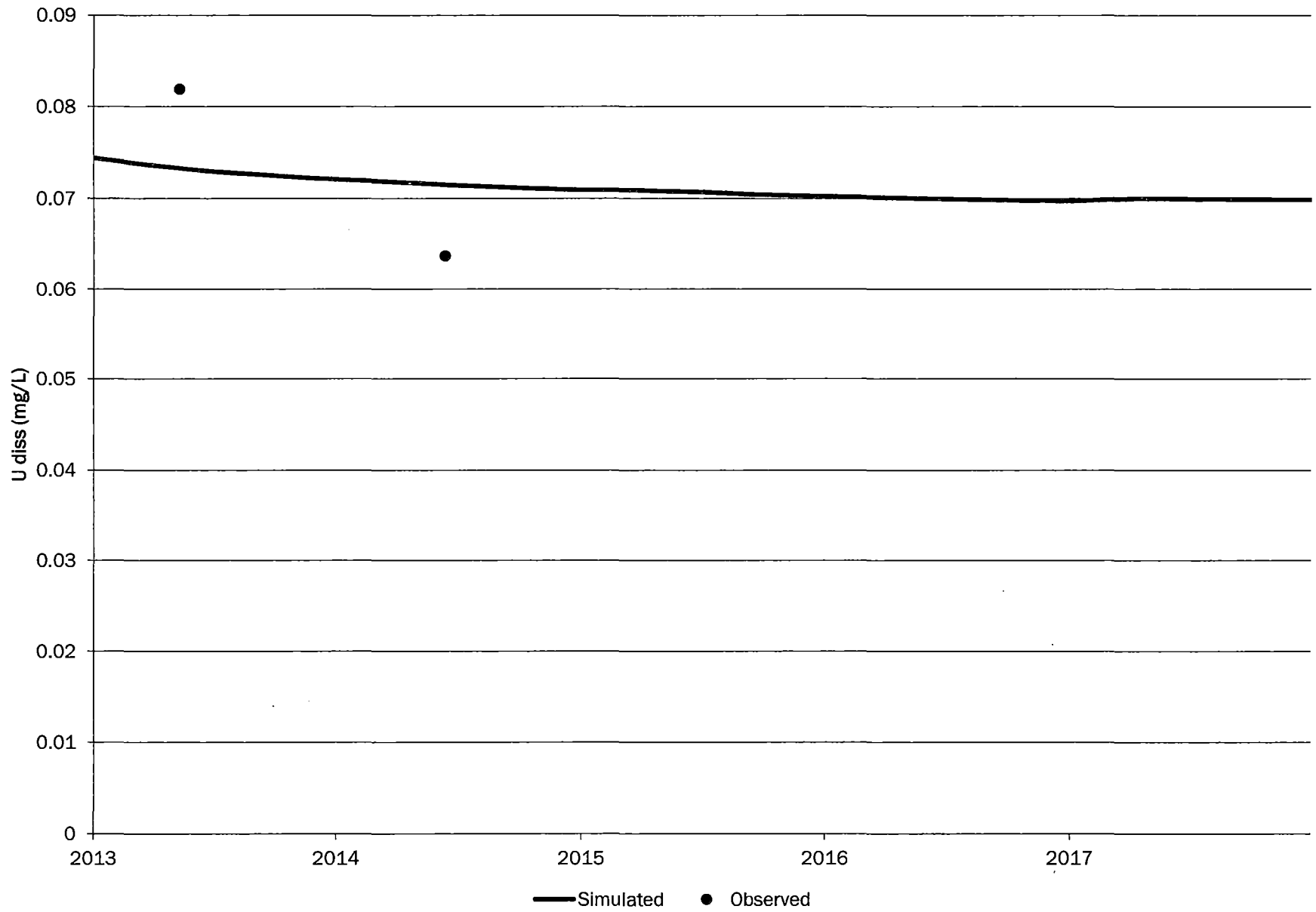
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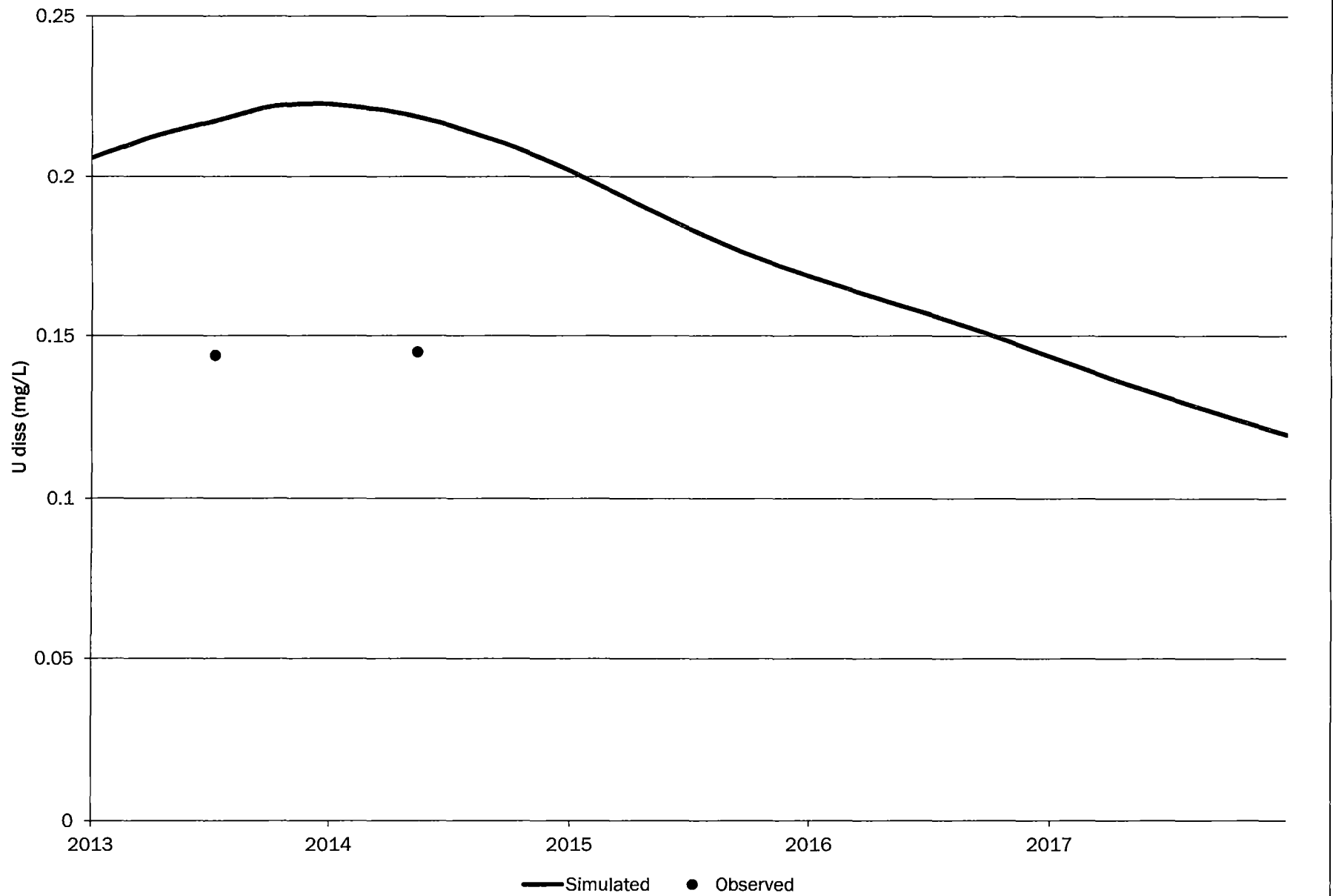
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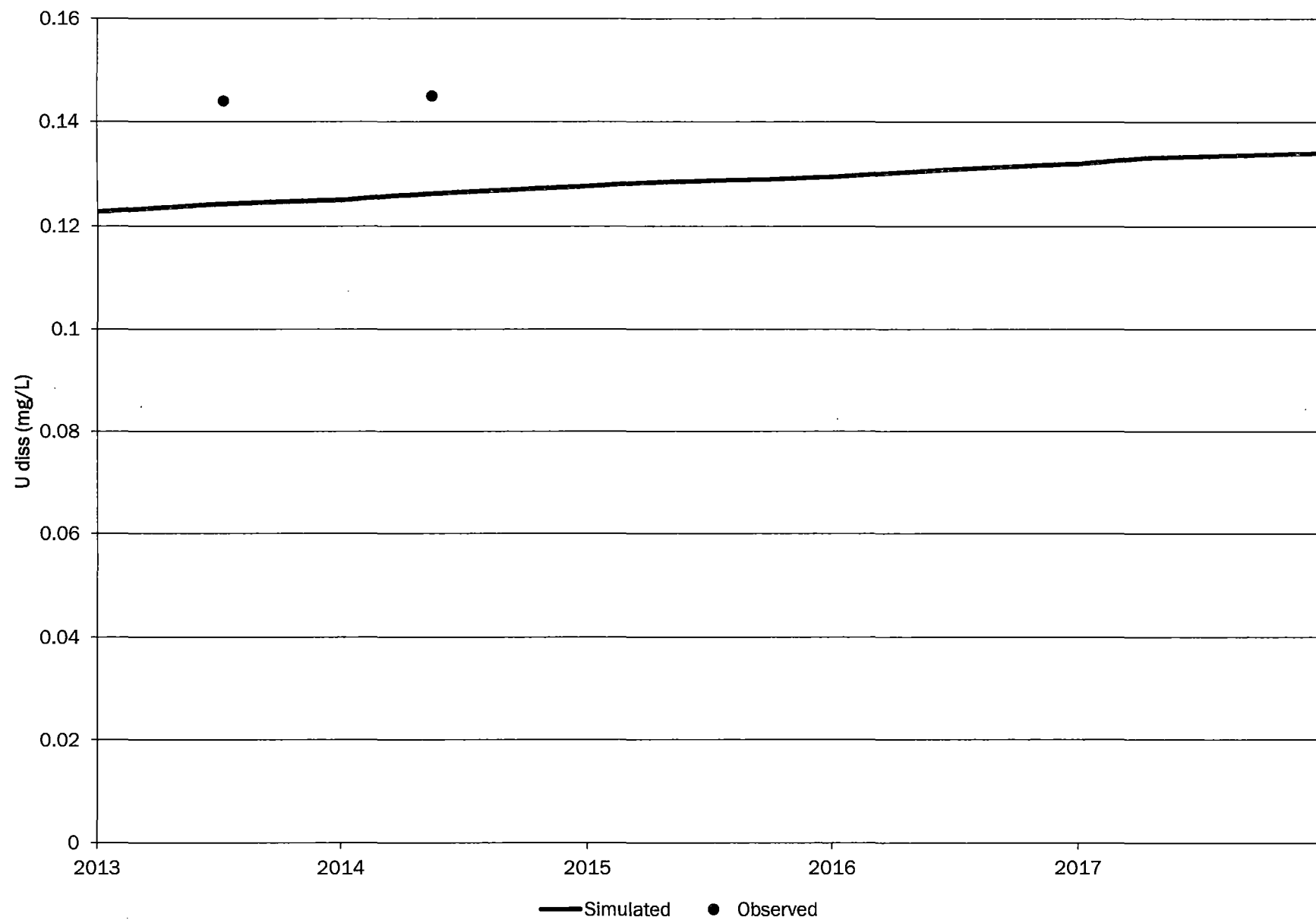
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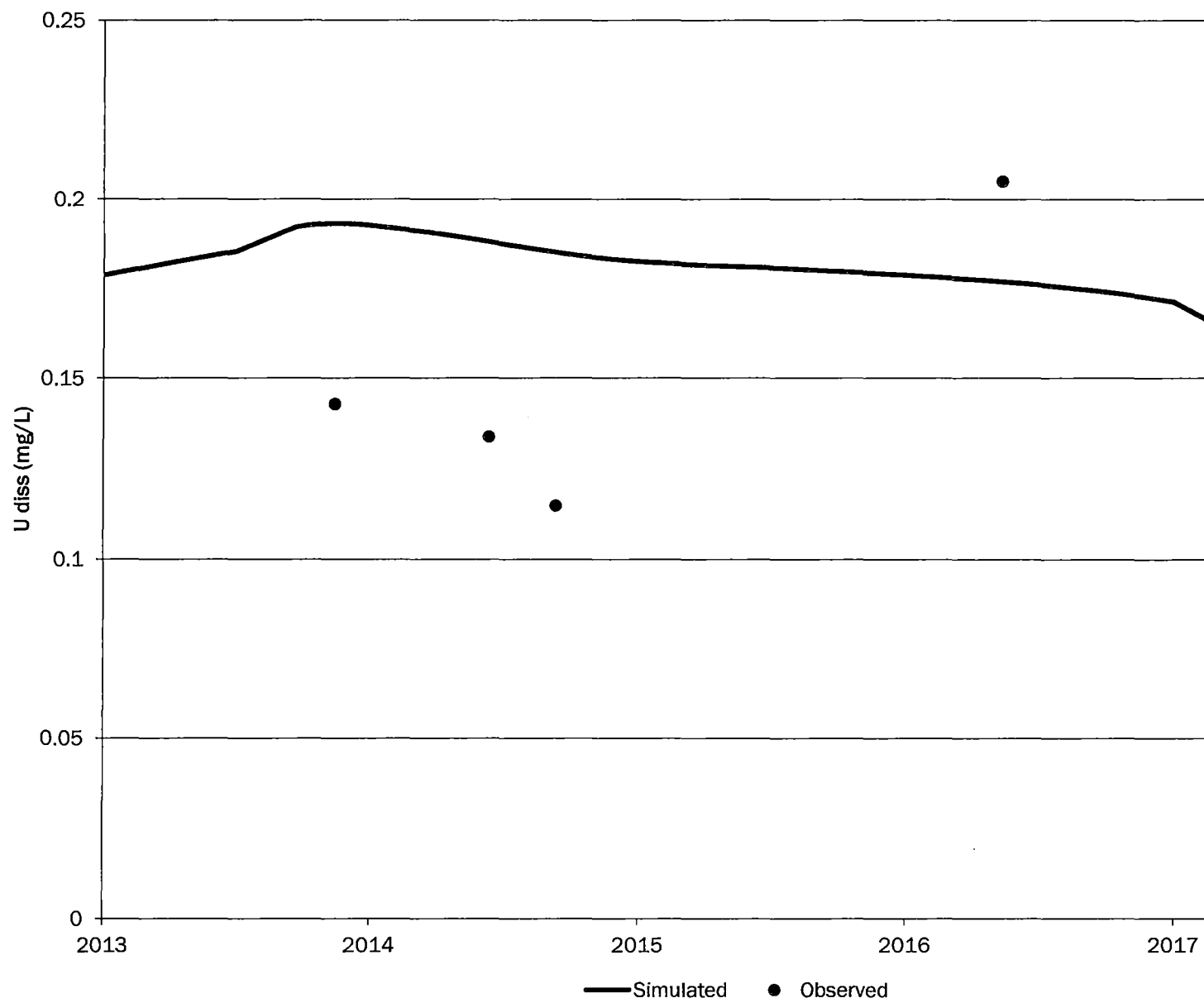
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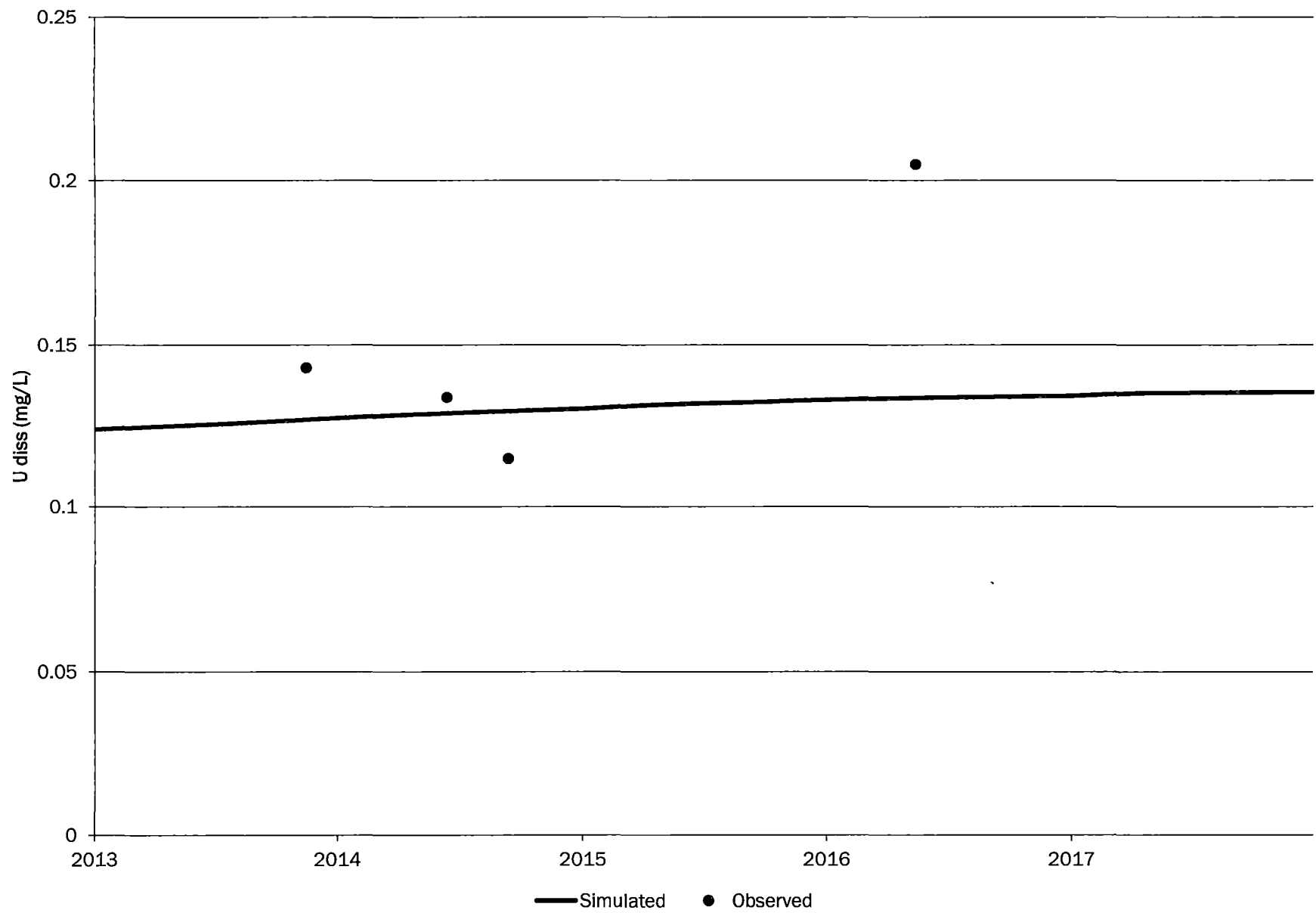
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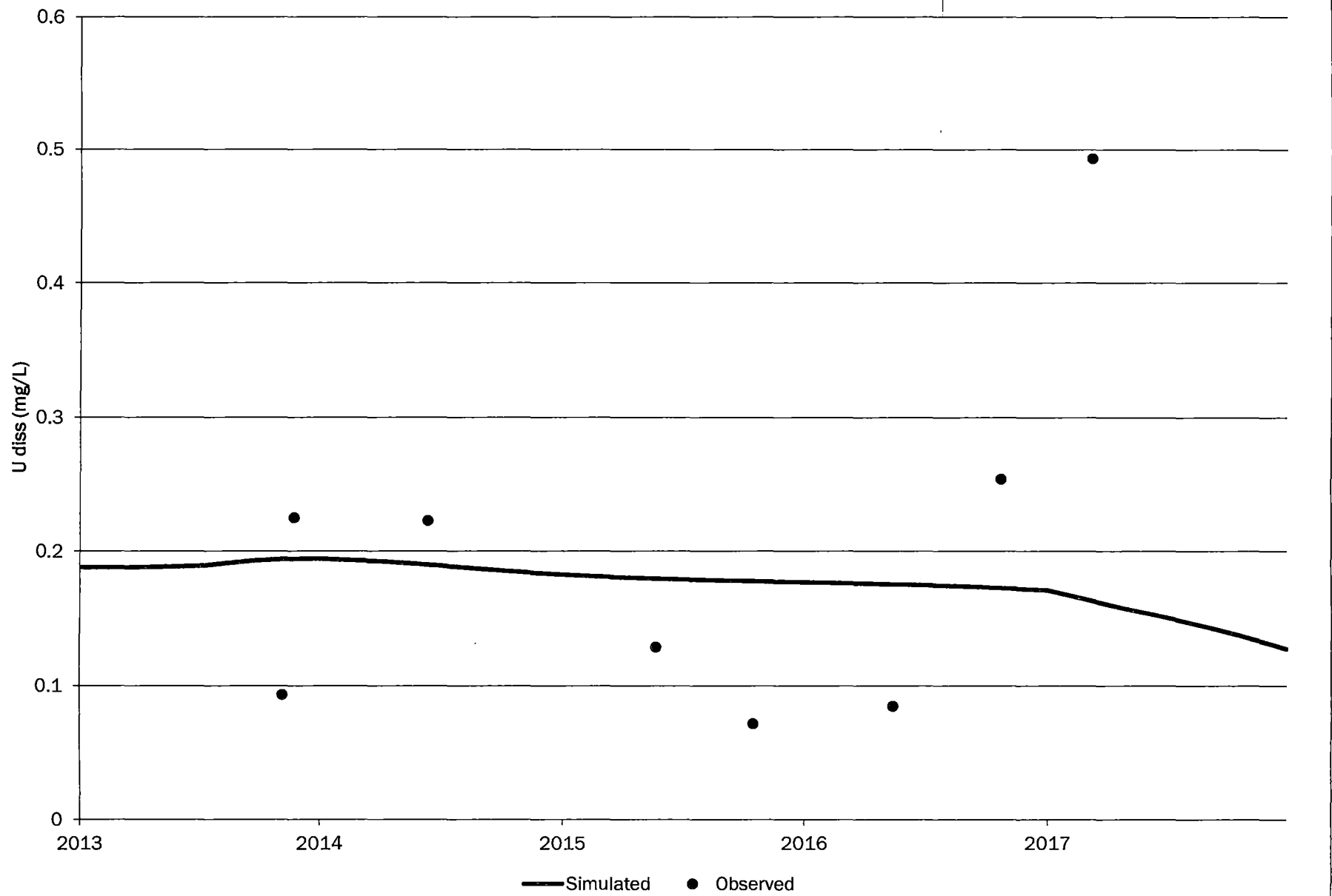
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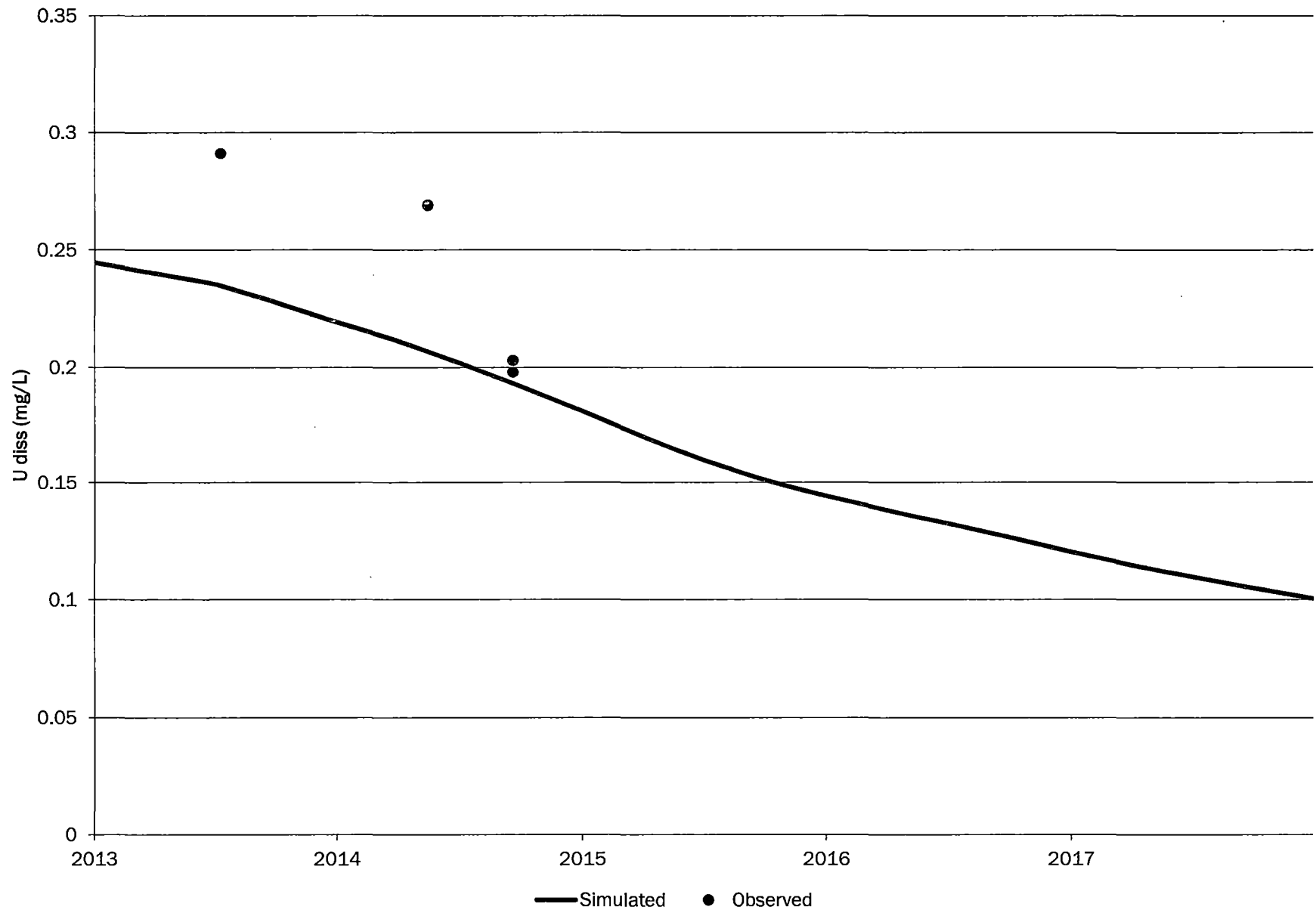
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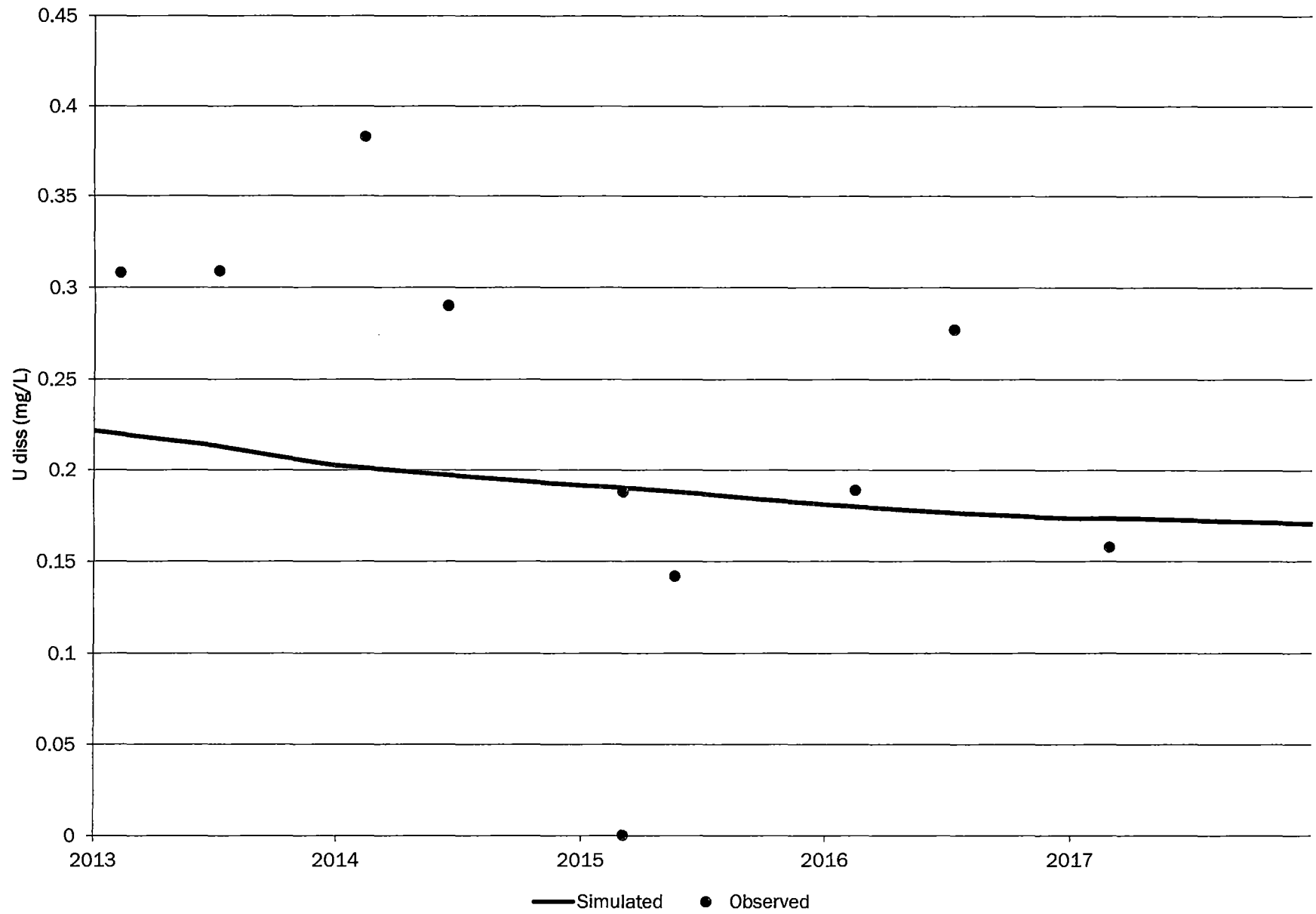
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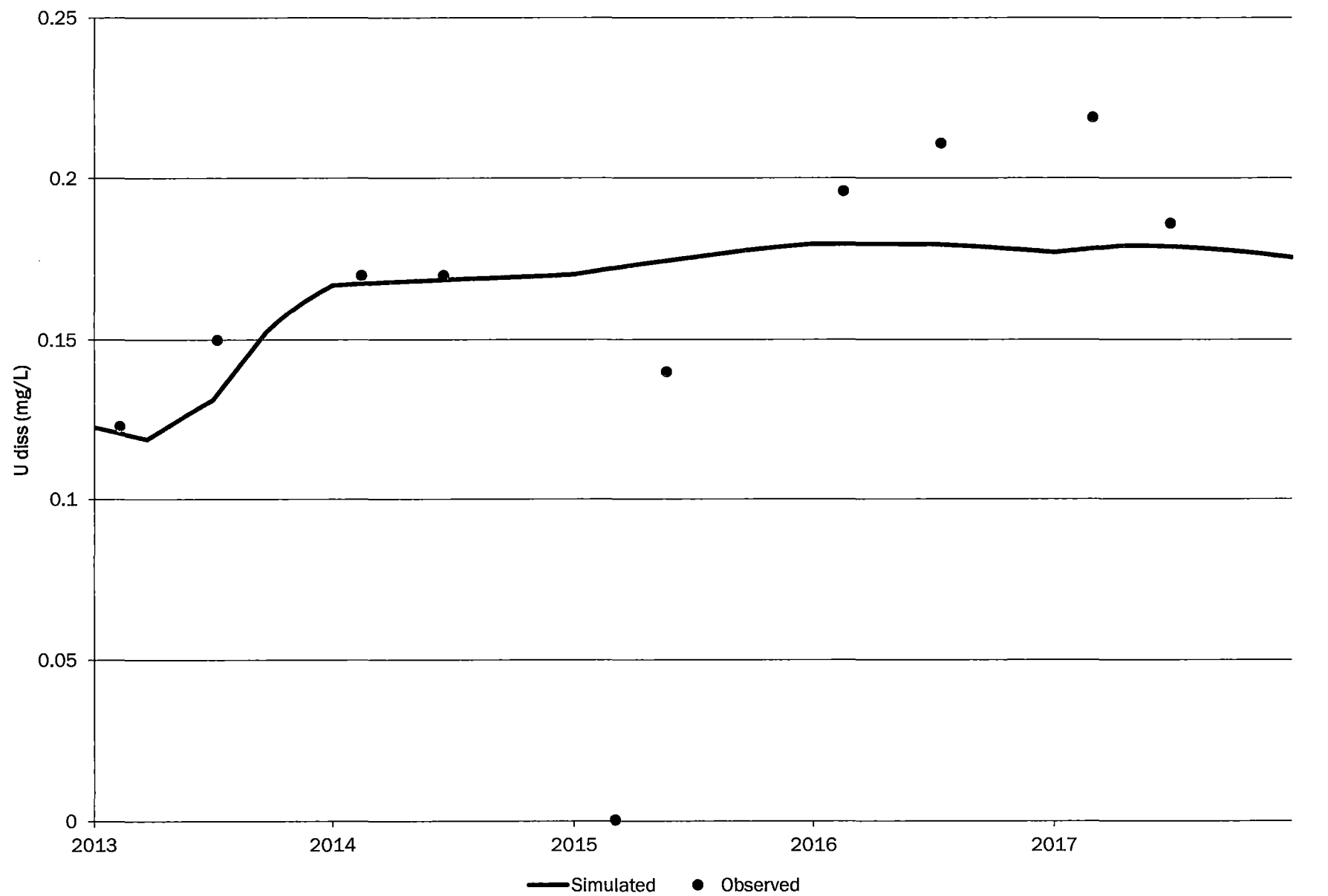
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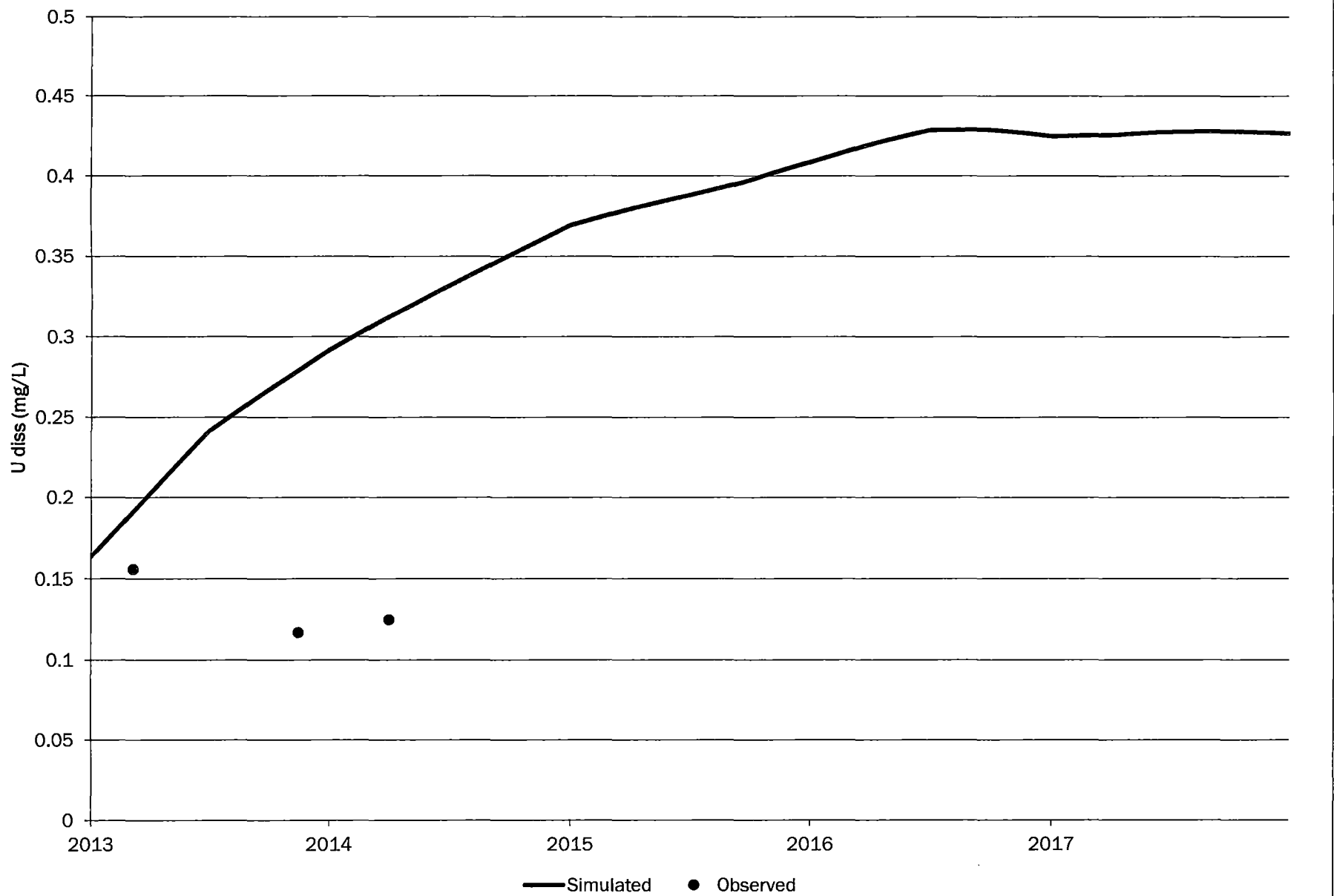
0493-MC



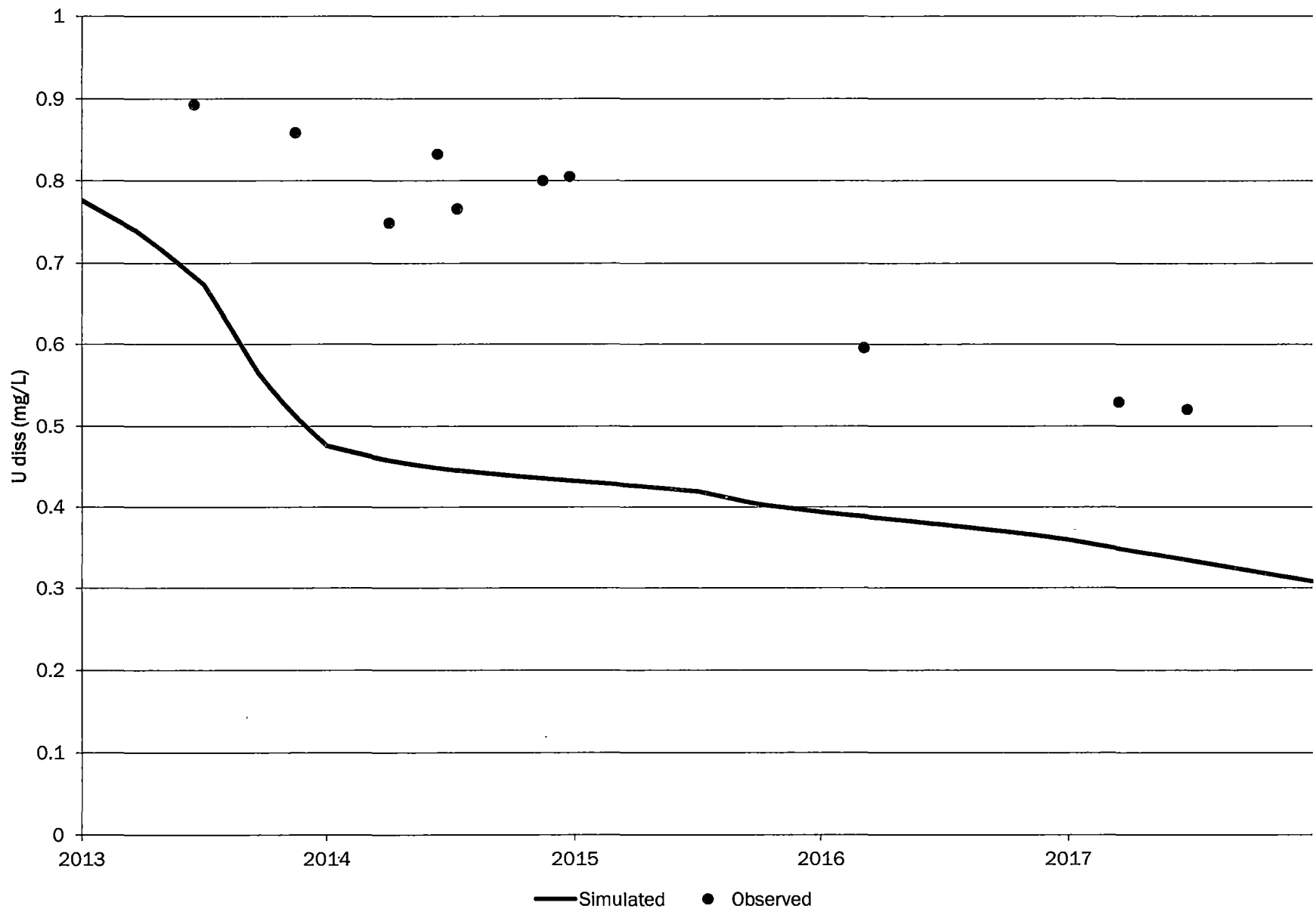
0494-UC



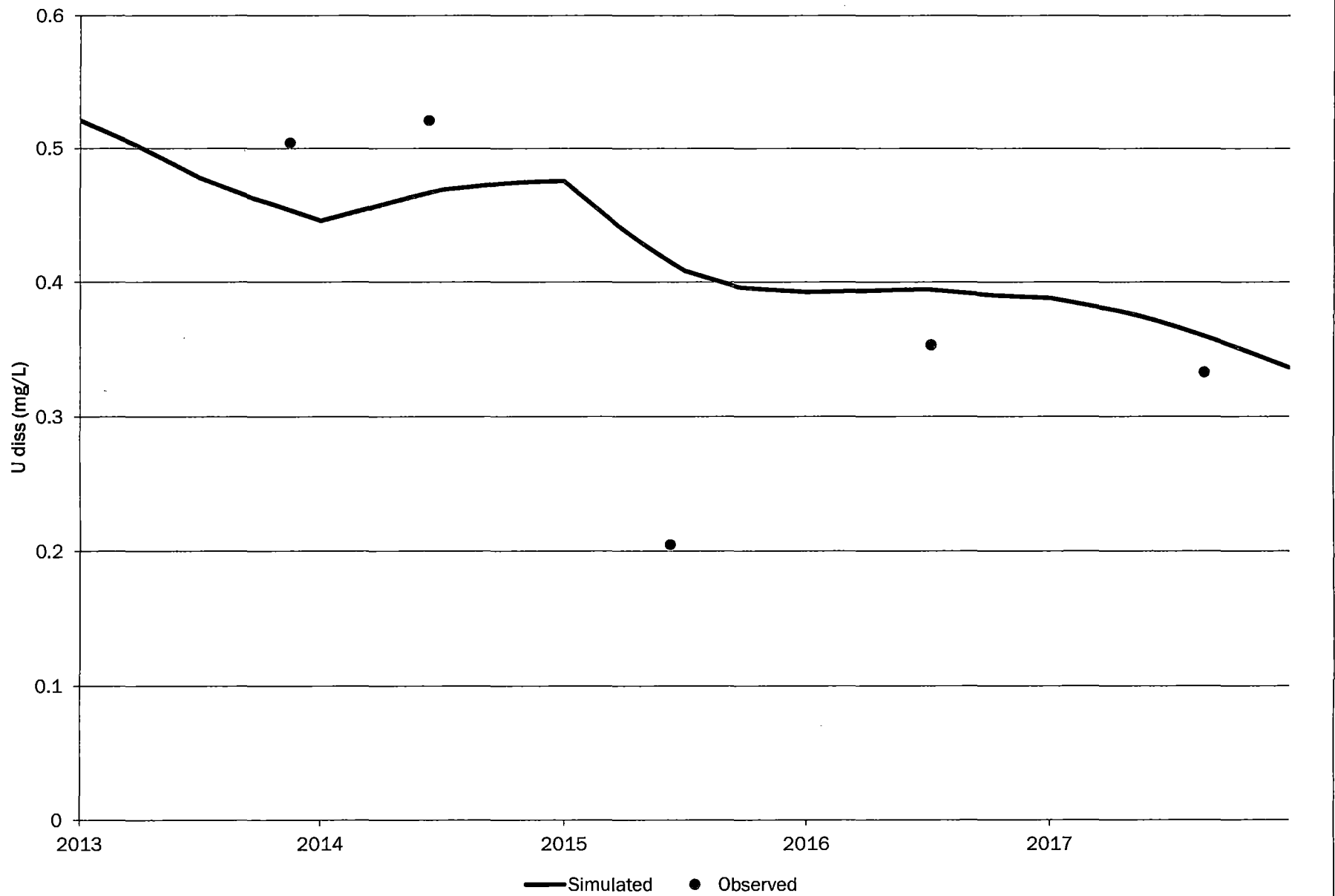
0496-AI



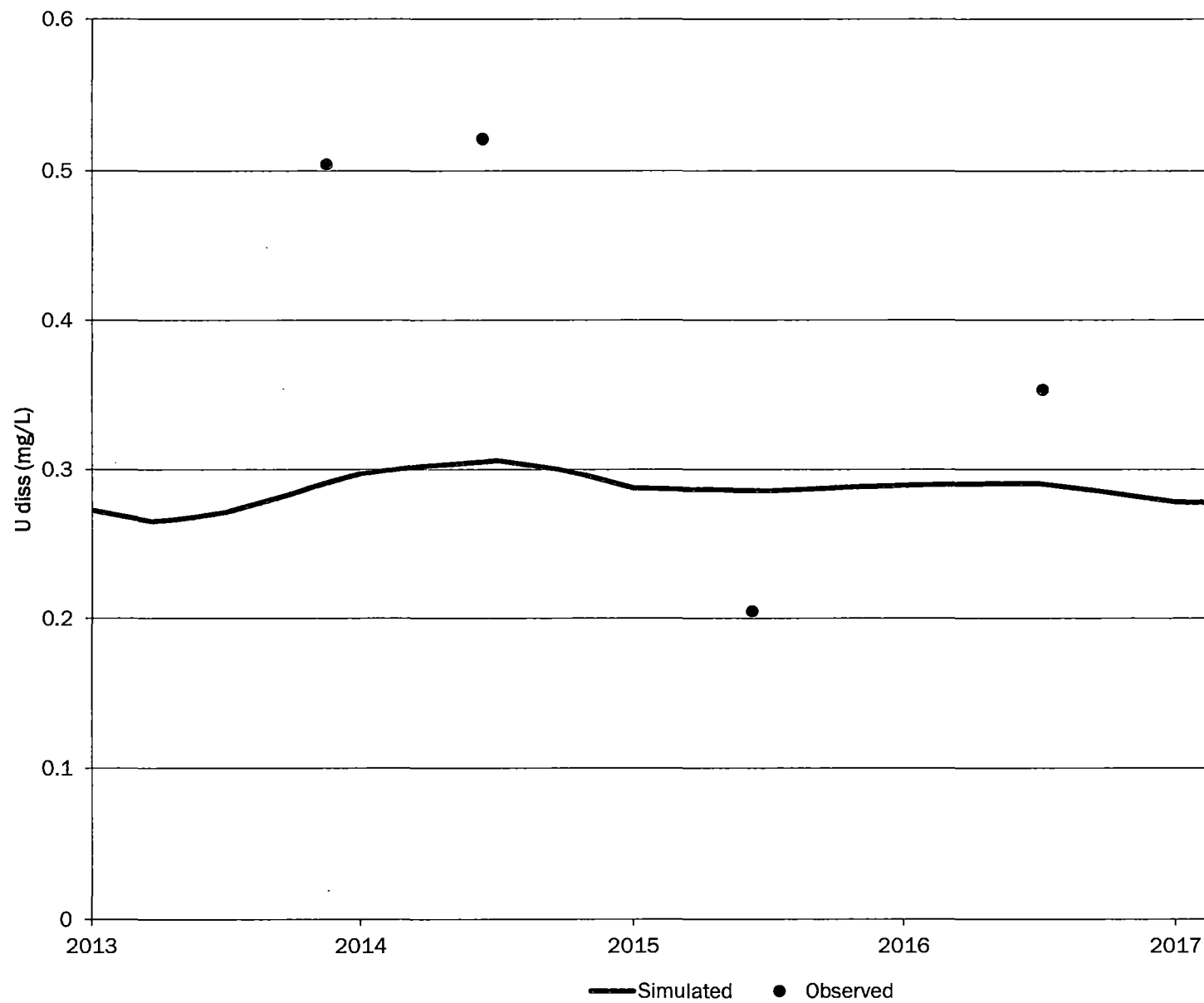
0497-AI



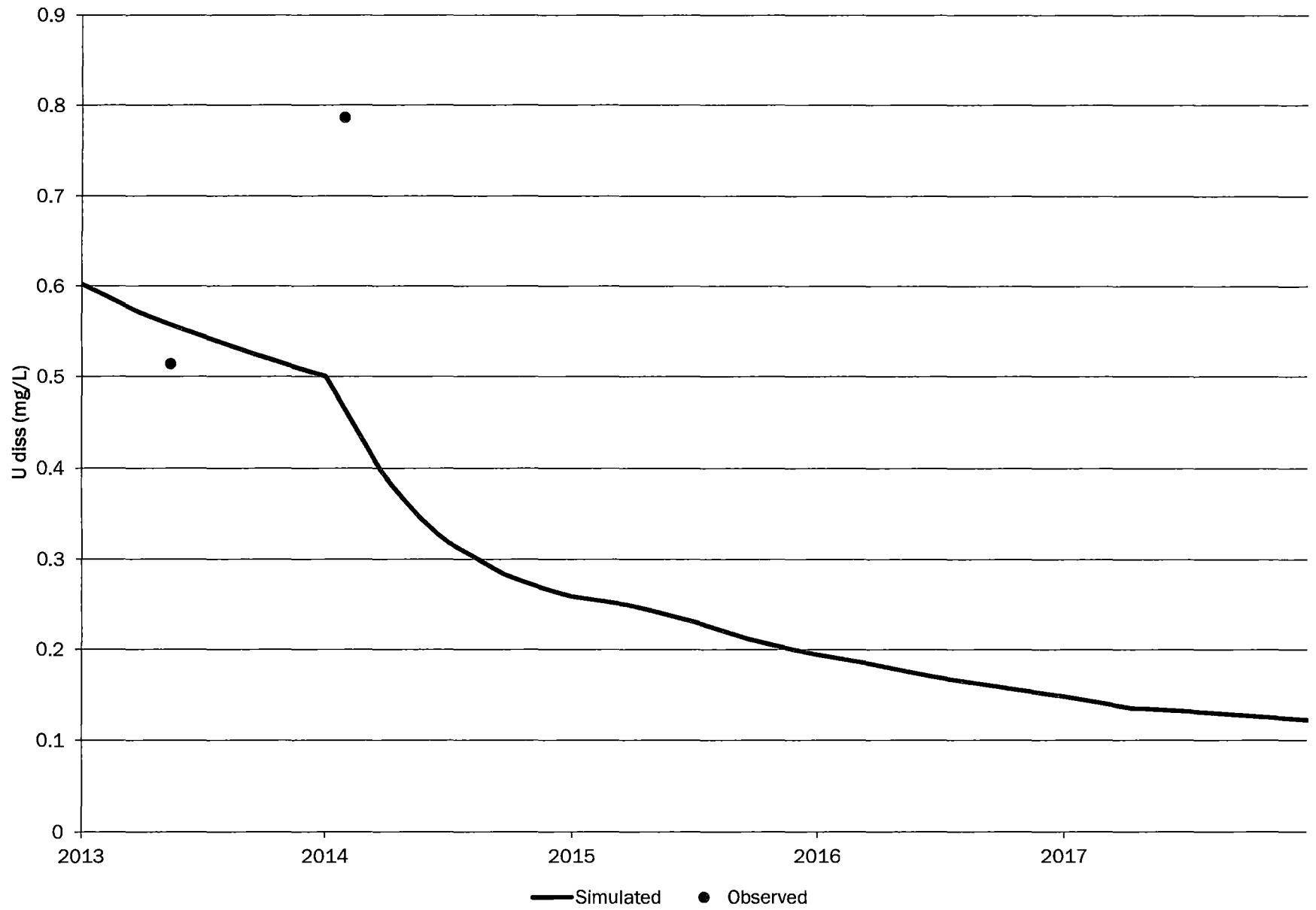
0498-AI



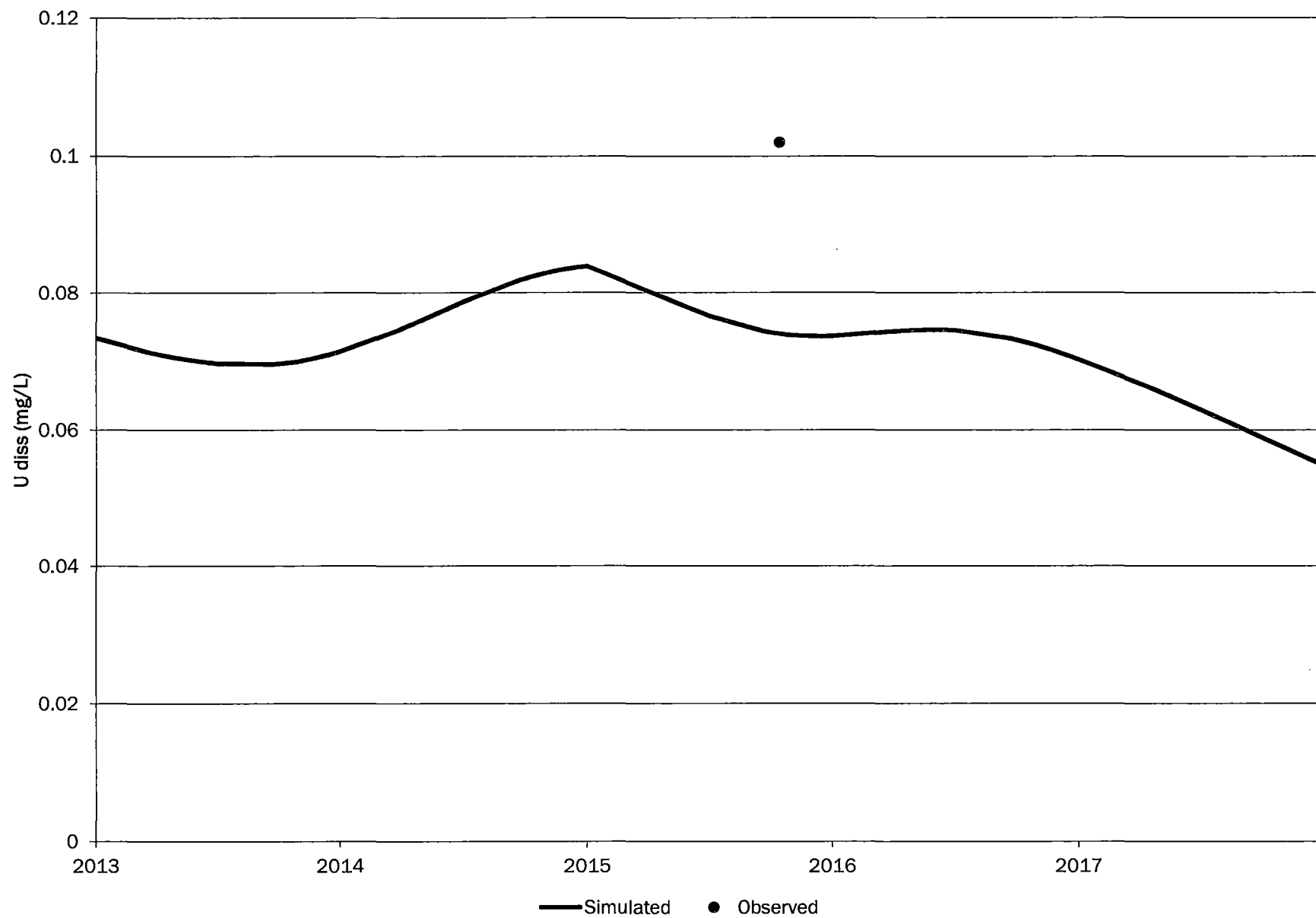
0498-MC



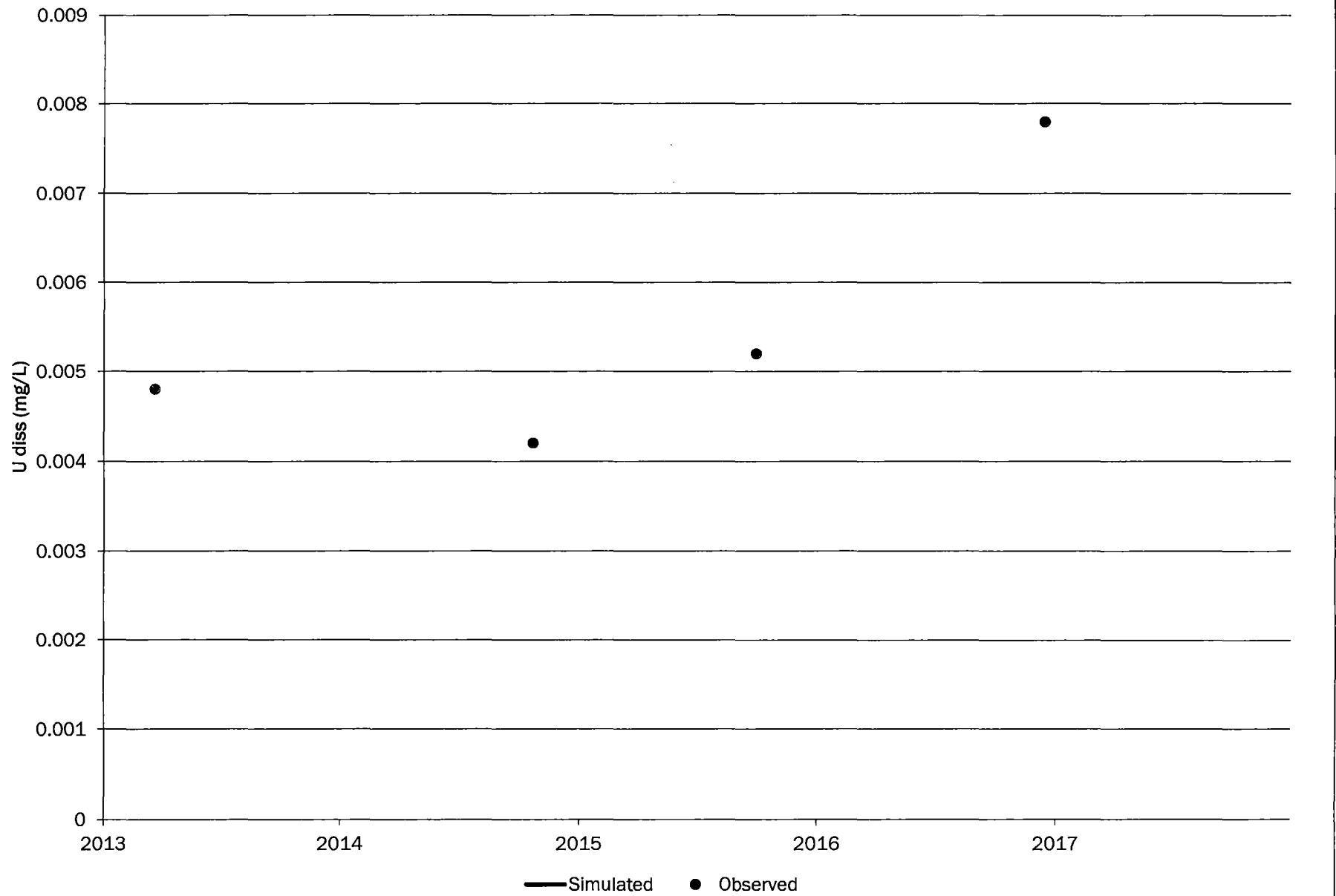
0522-AI



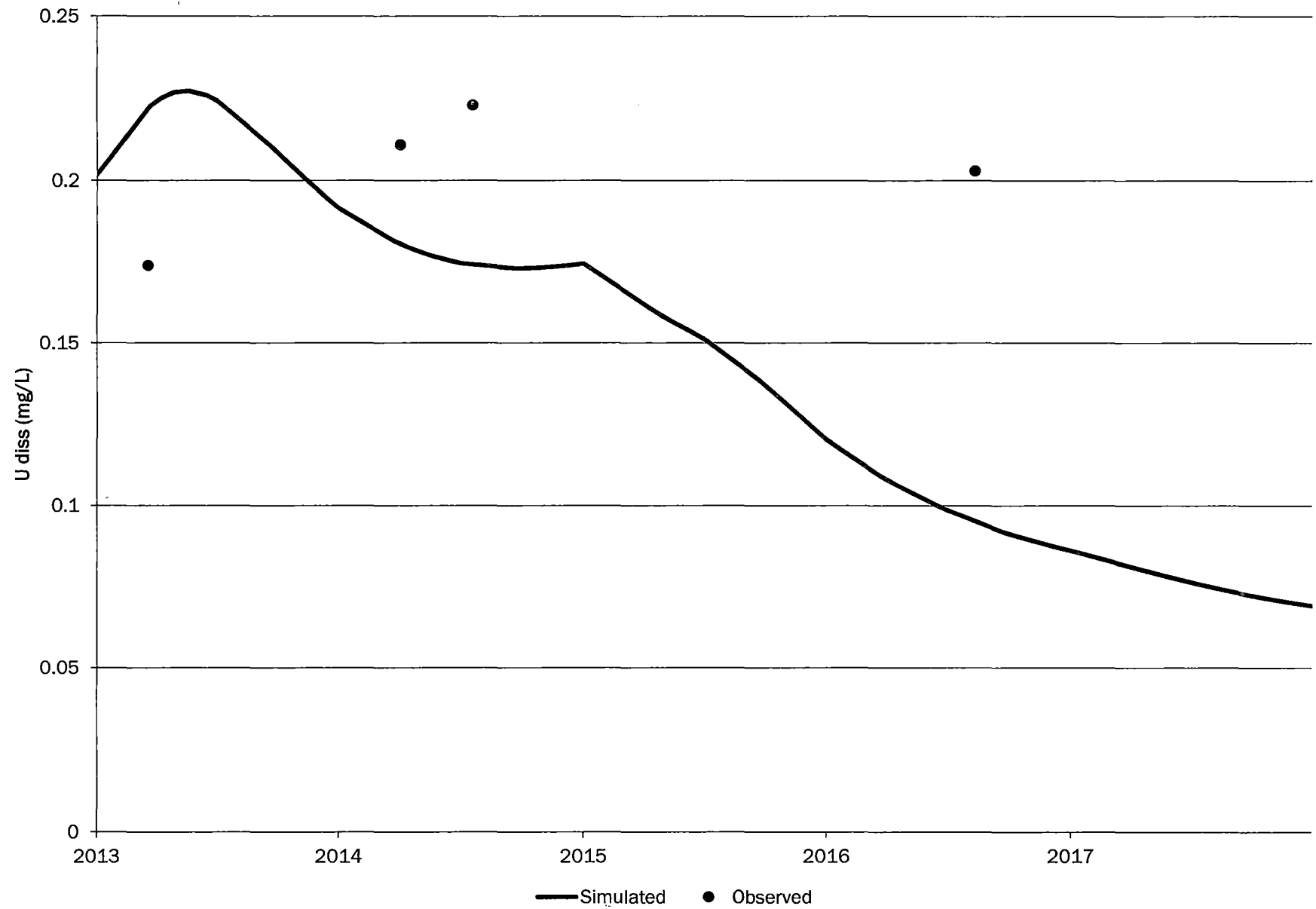
0531-AI



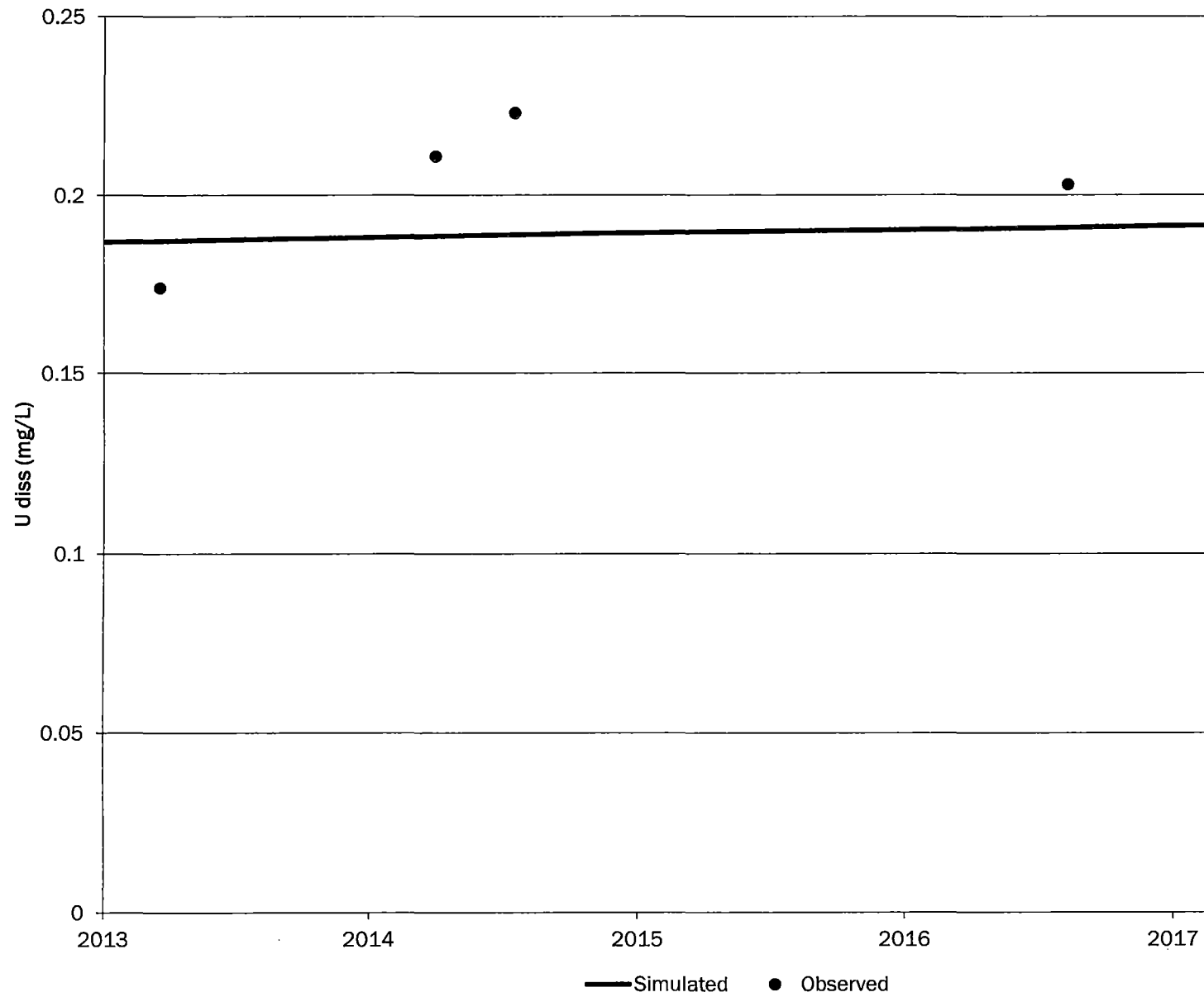
0532-AI



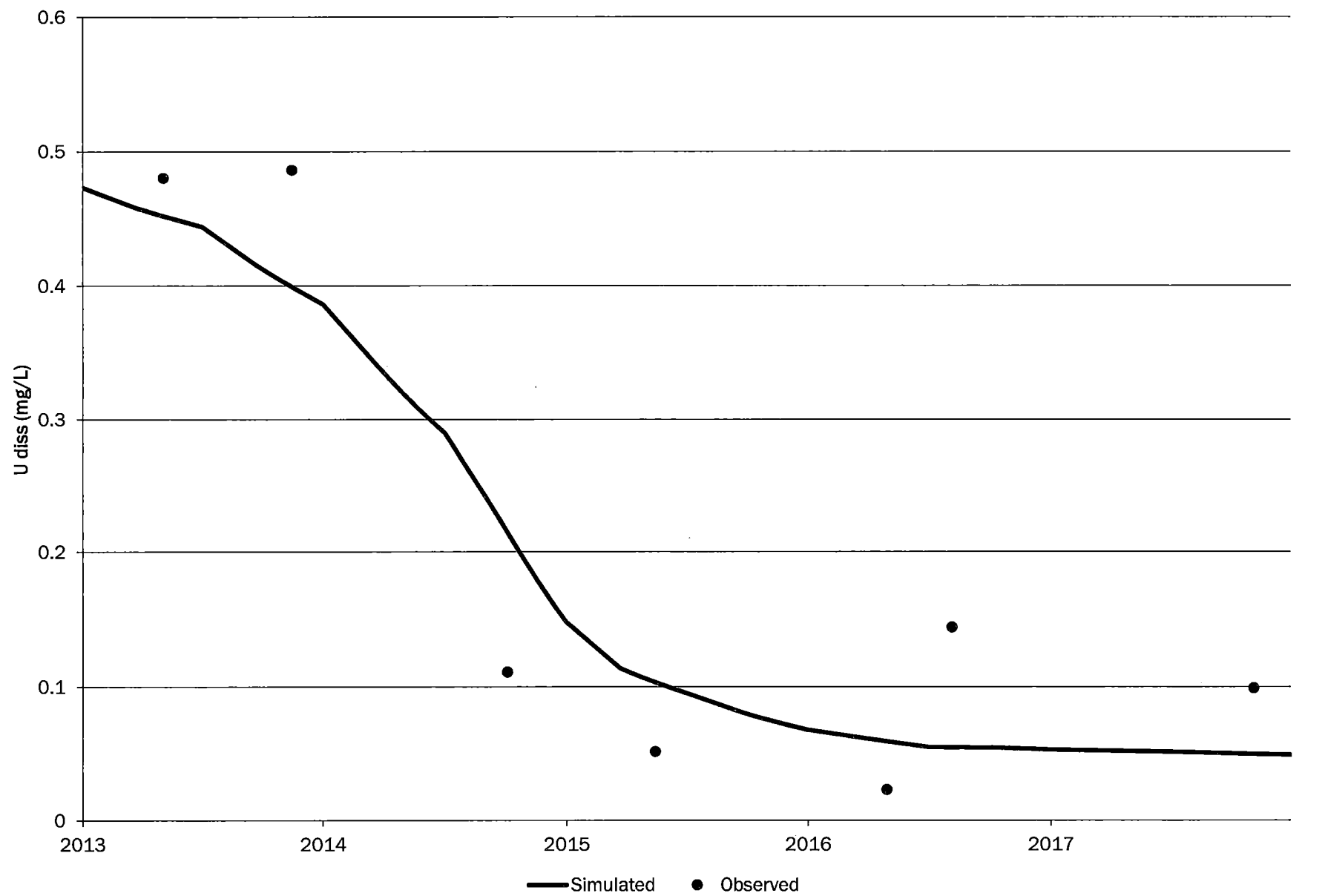
0538-AI



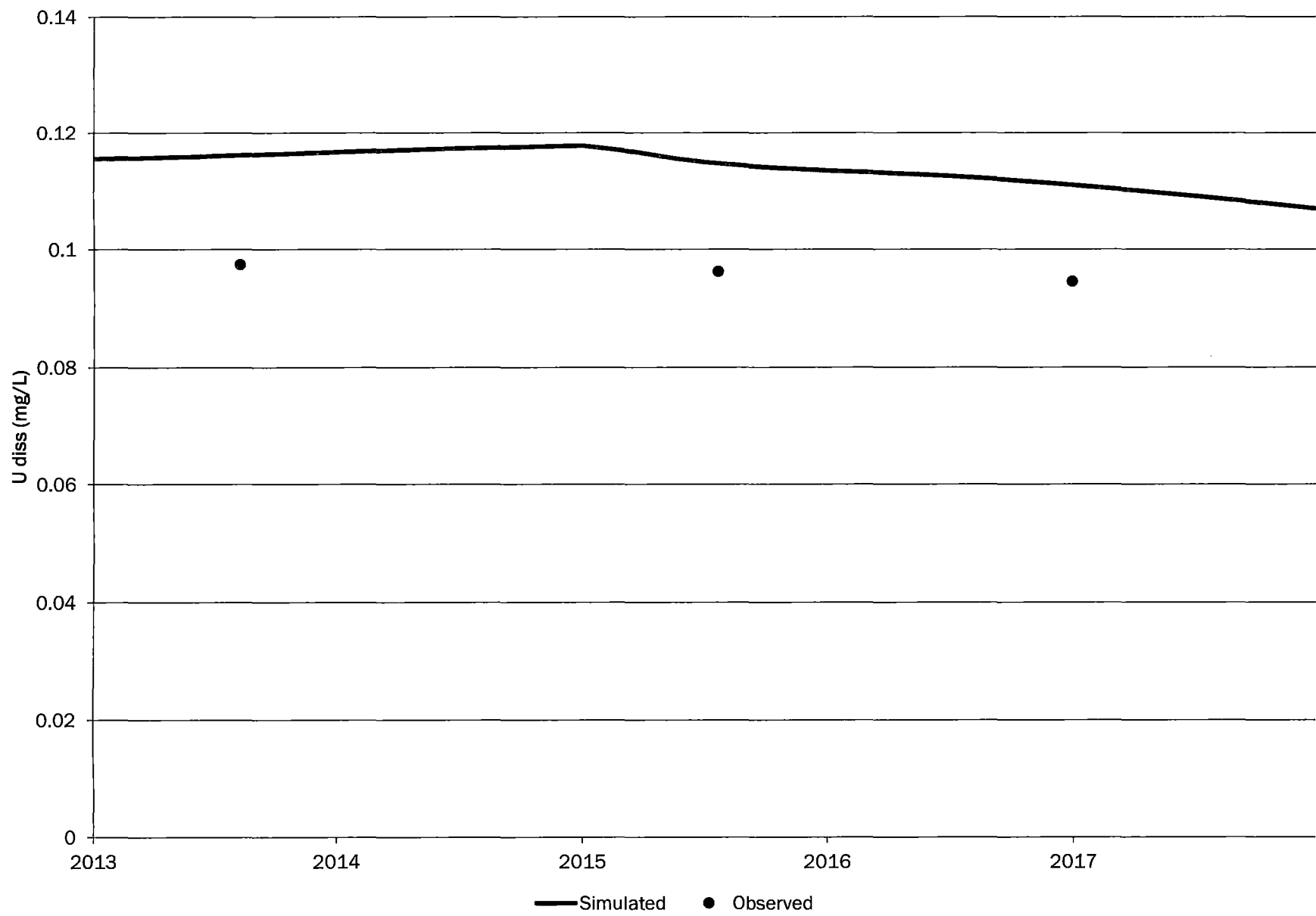
0538-LC



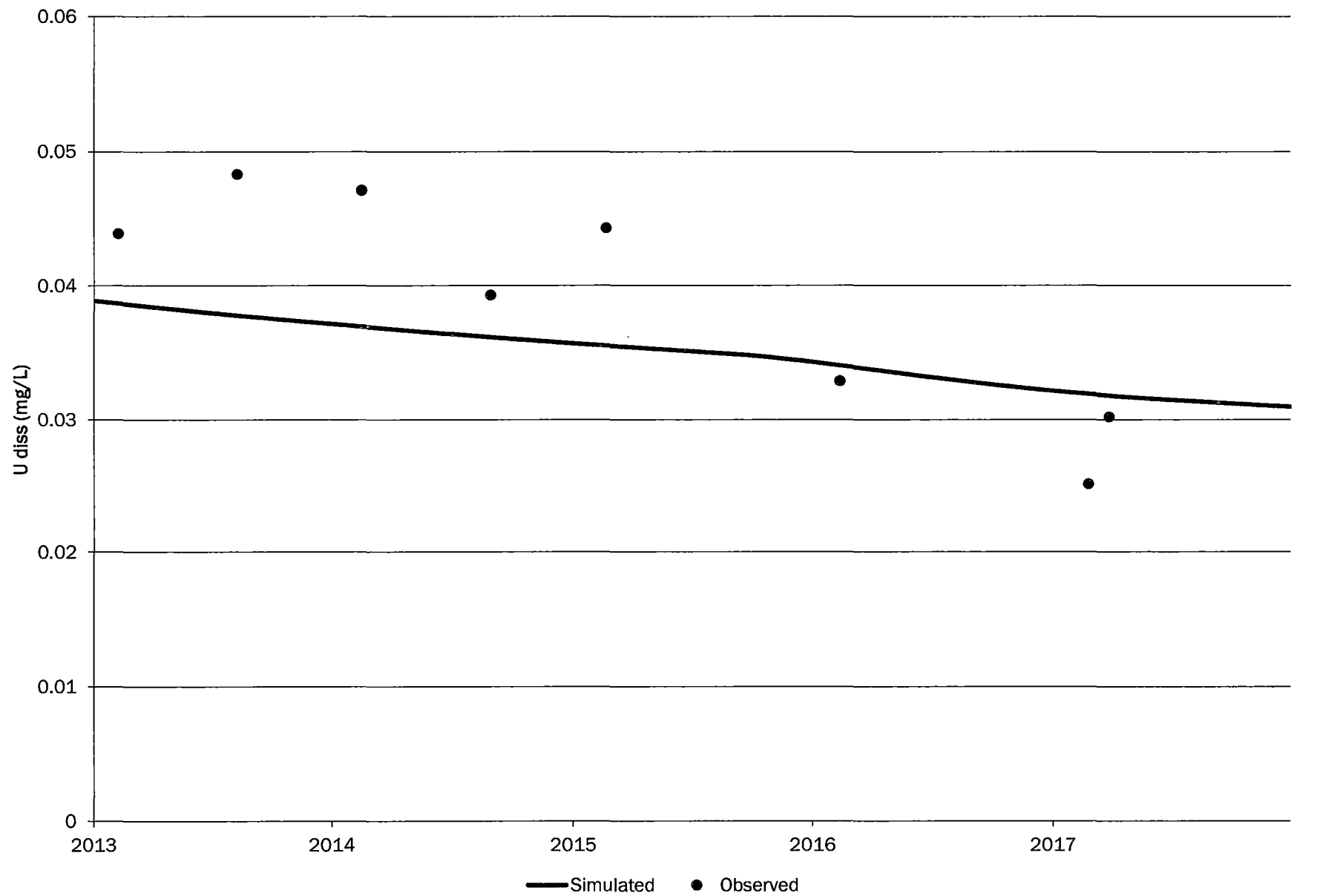
0540-AI



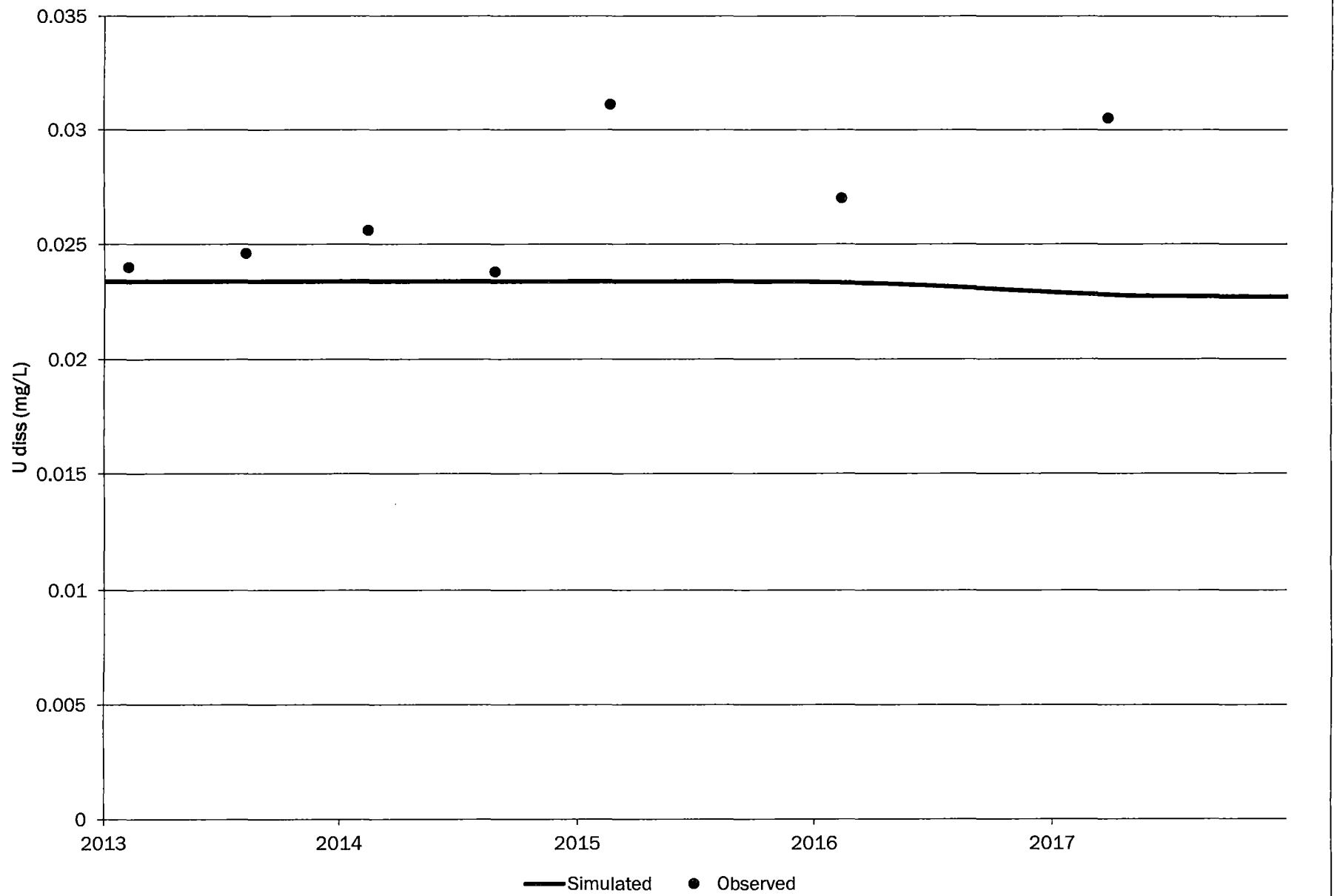
0541-AI



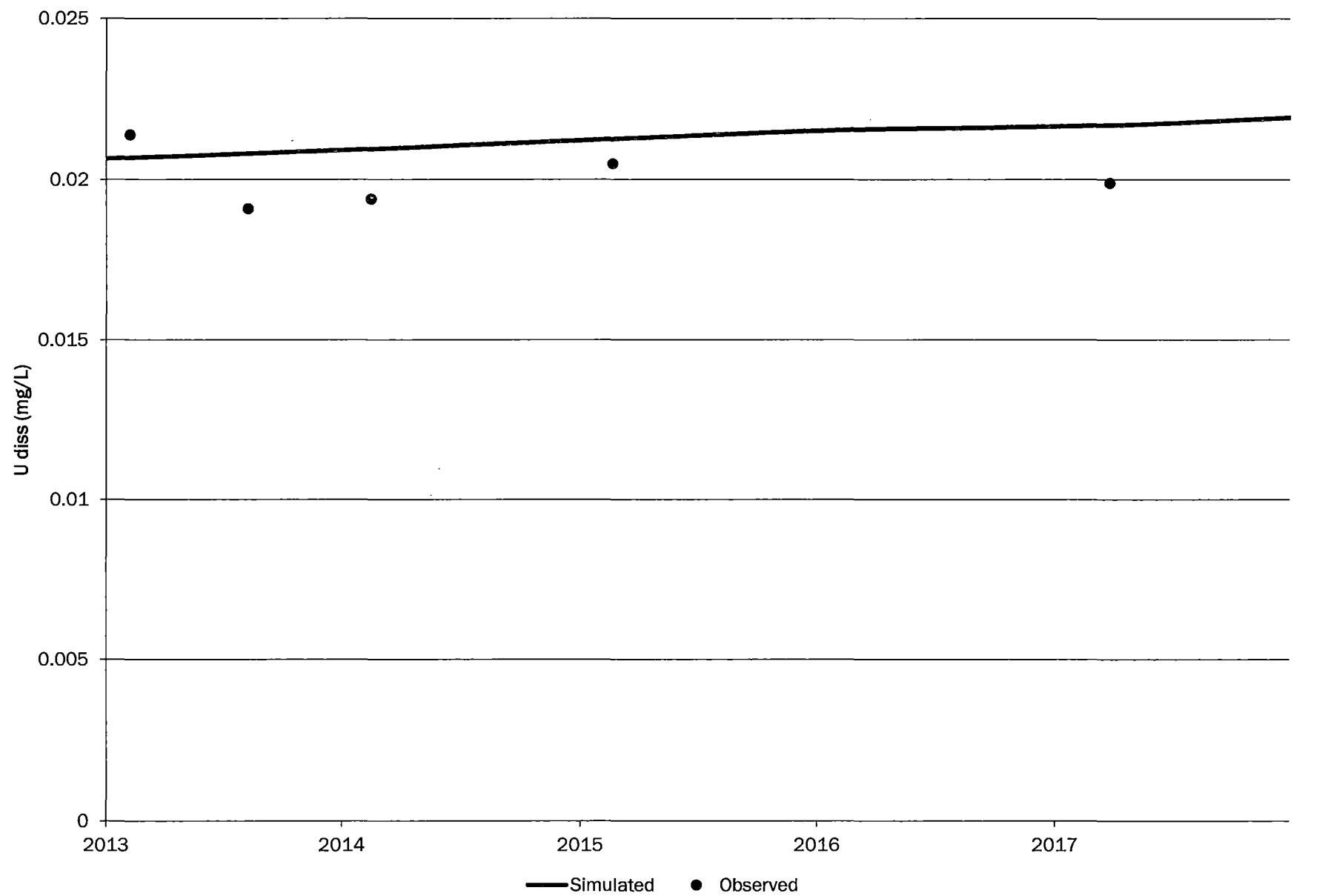
0551-AI



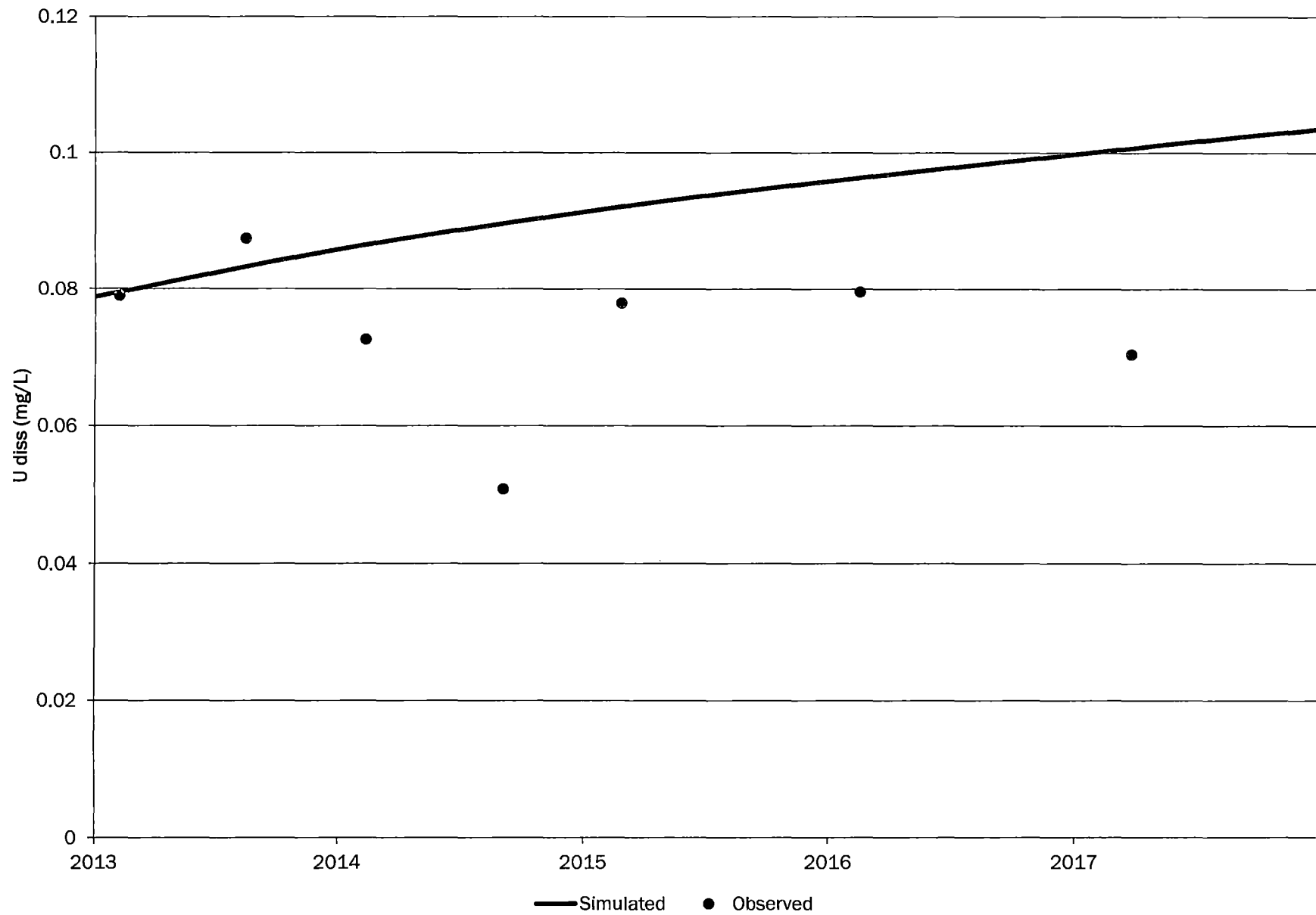
0553-AI



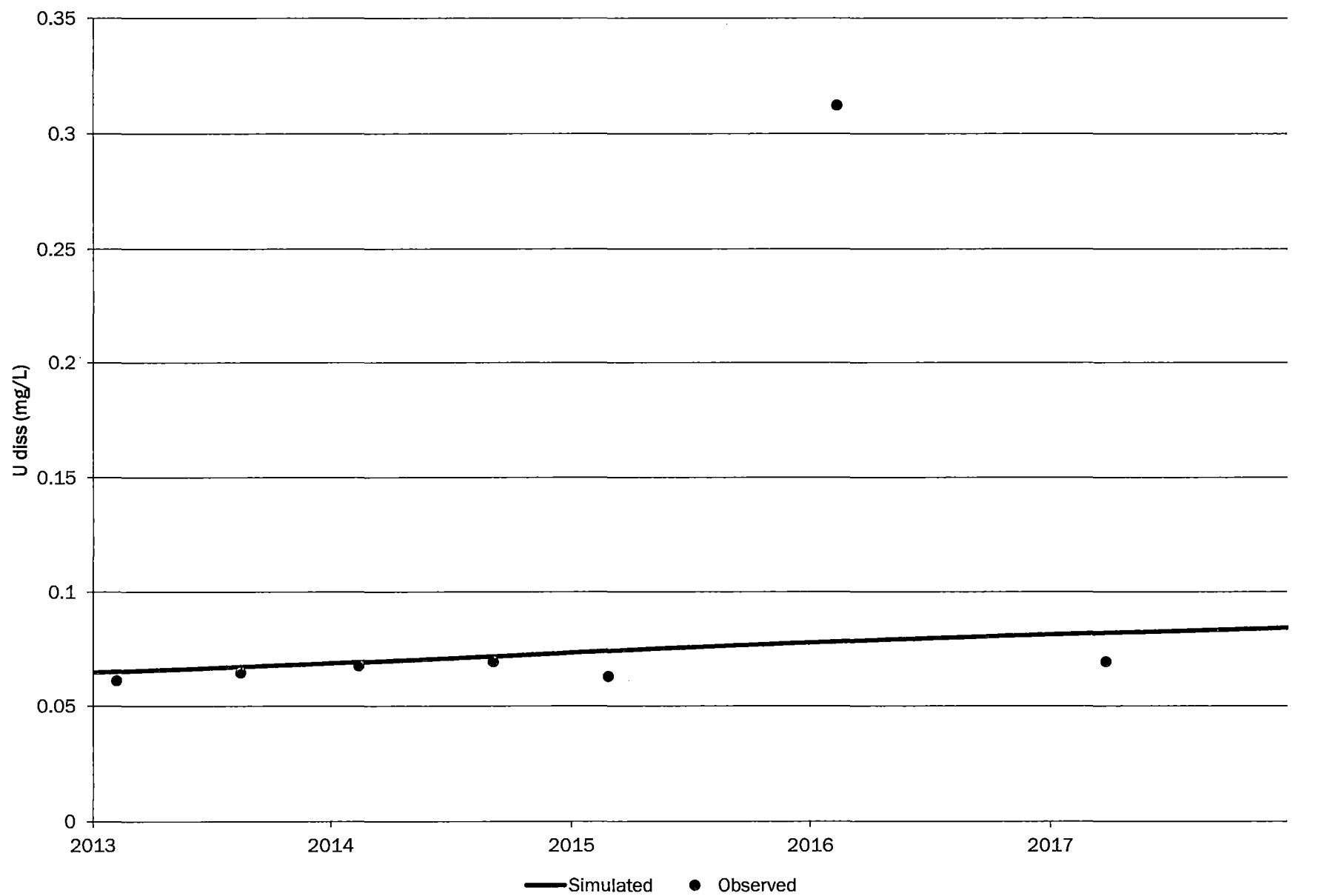
0554-AI



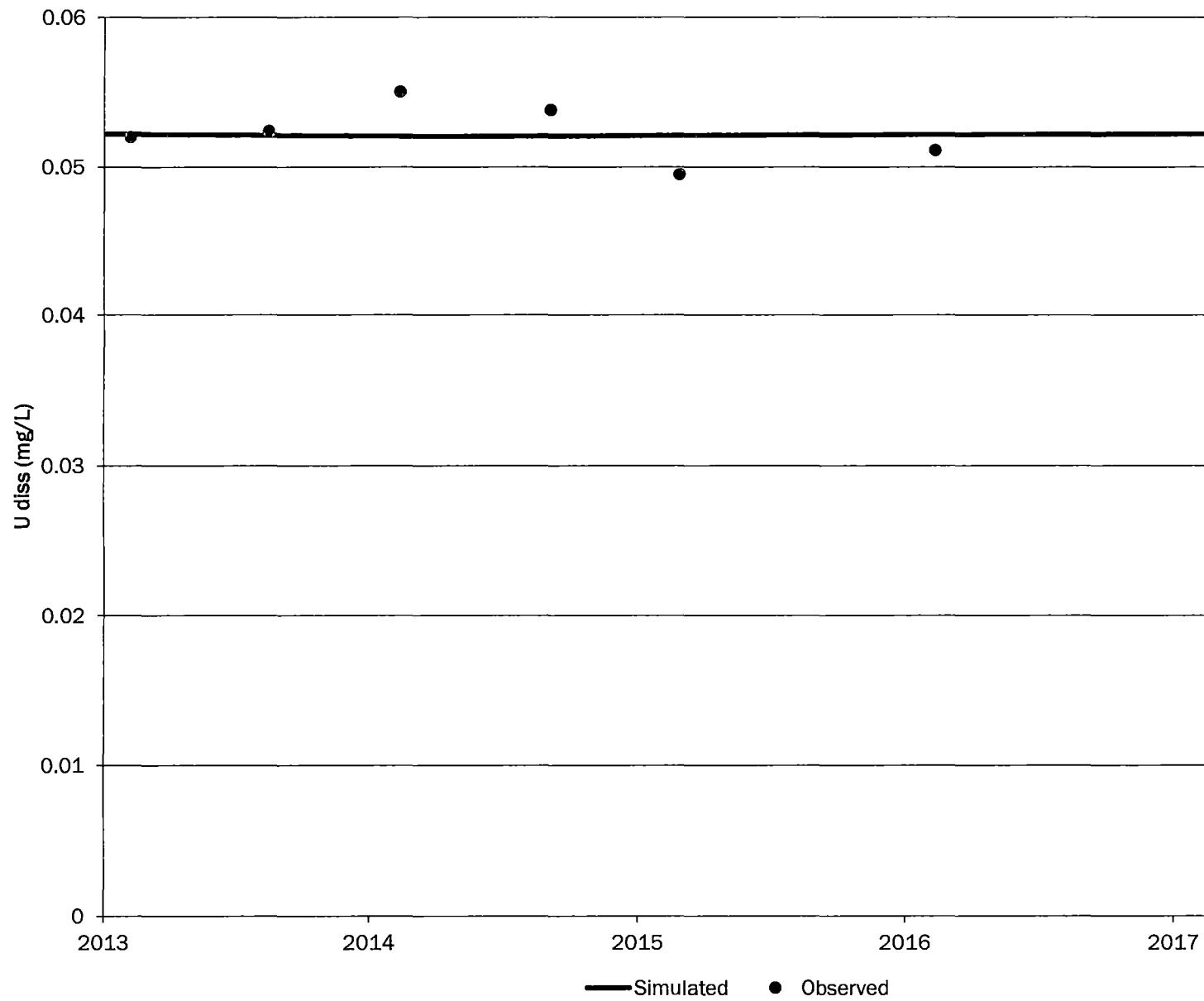
0555-AI



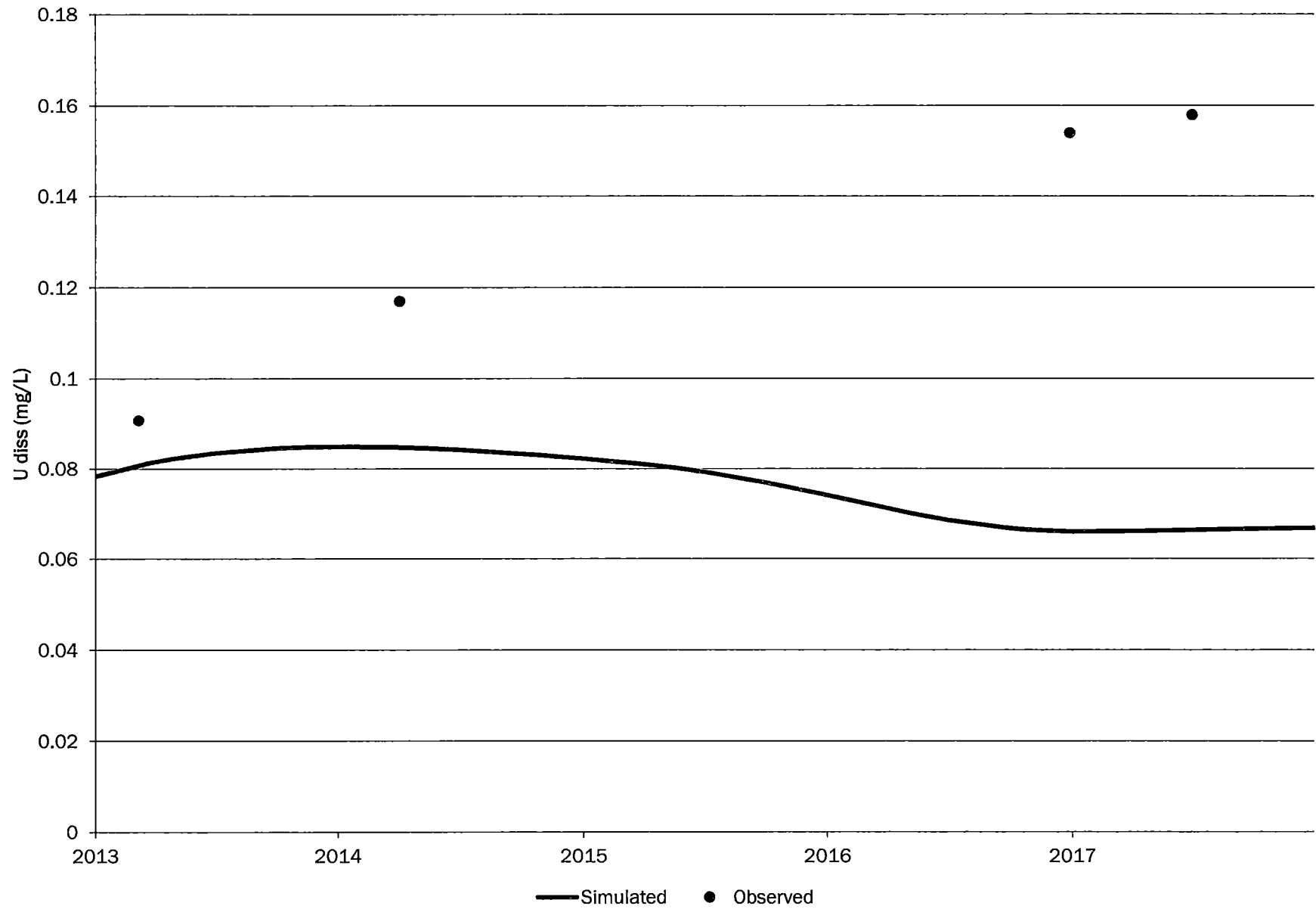
0556-AI



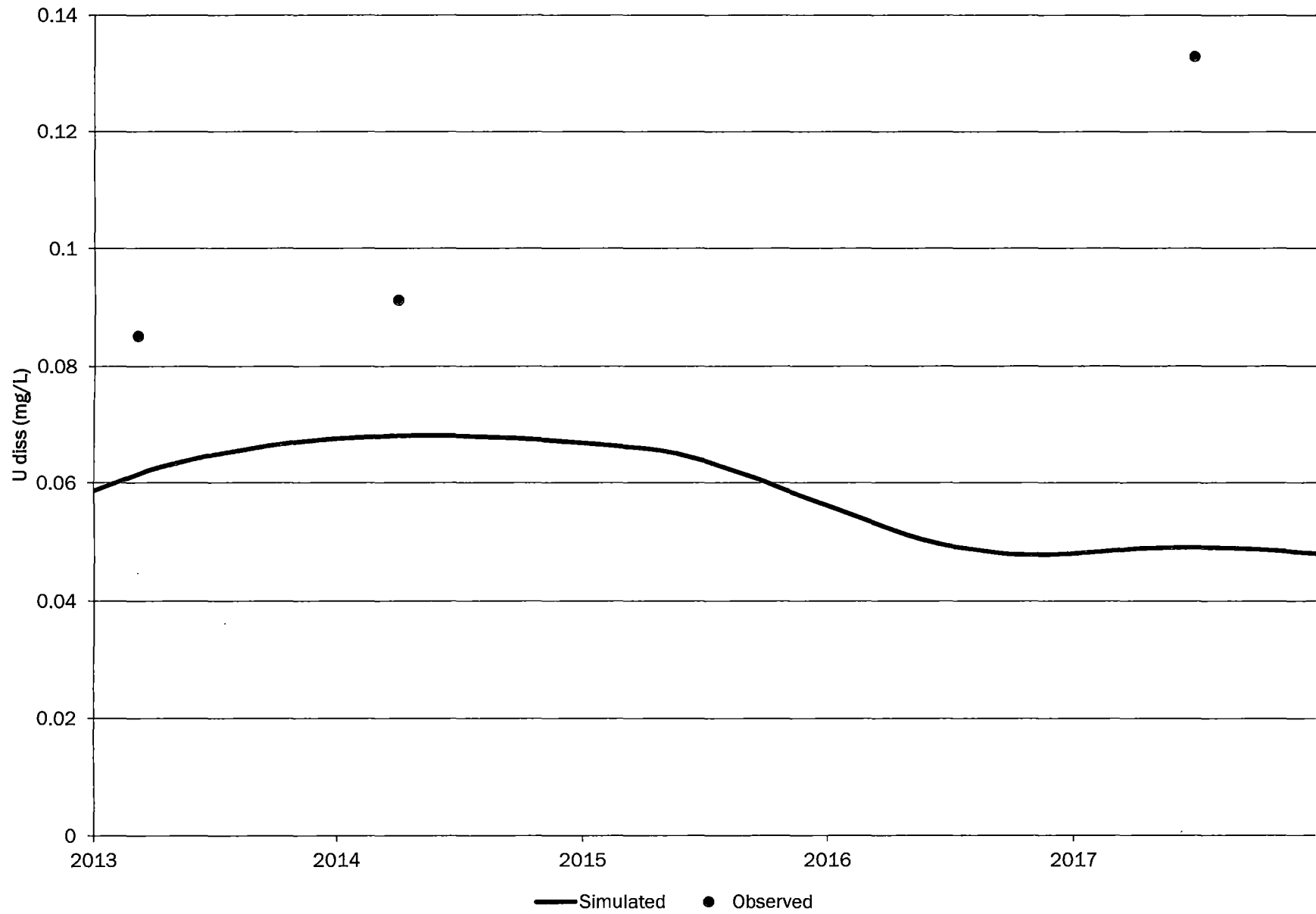
0557-AI



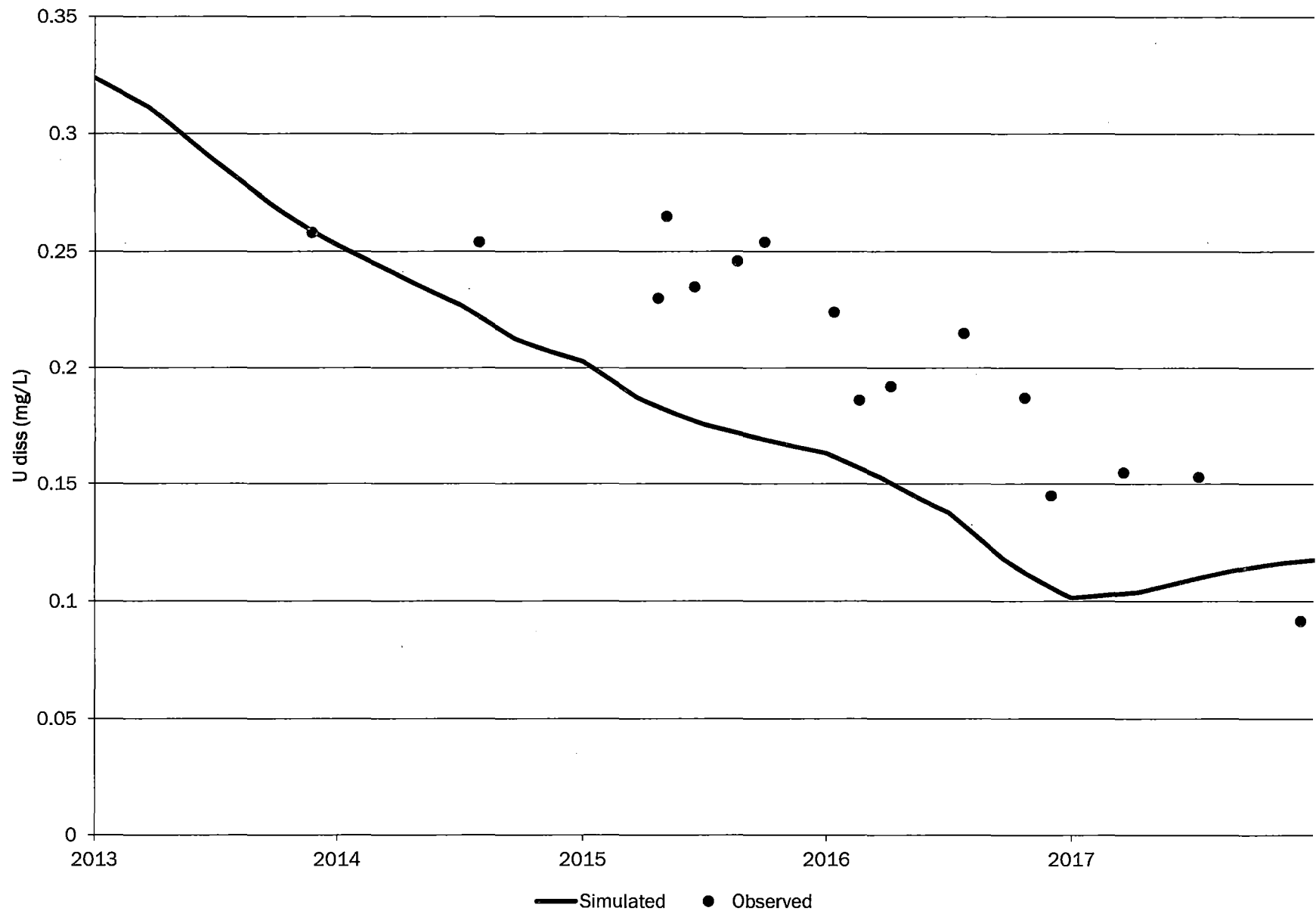
0631-AI



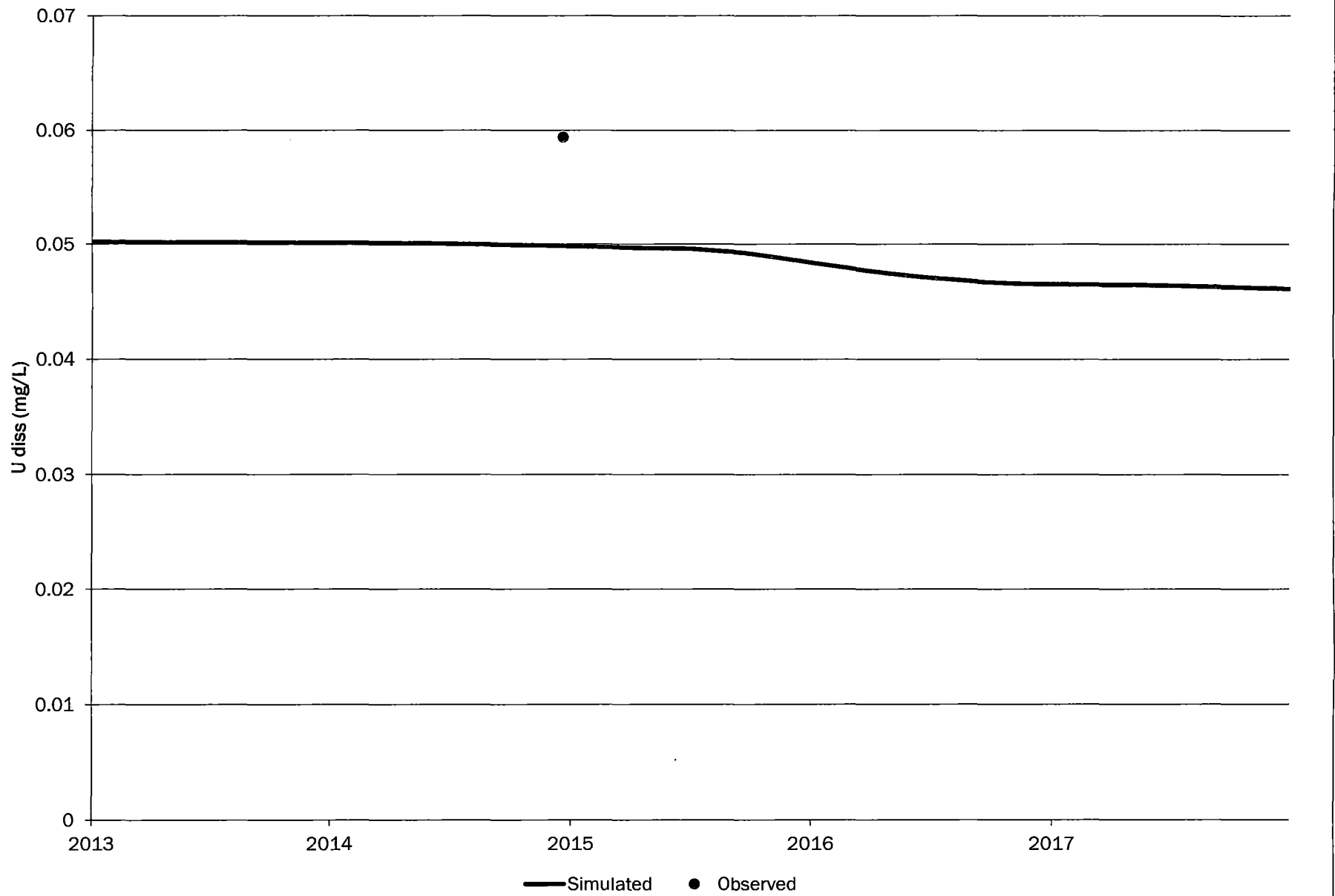
0632-AI



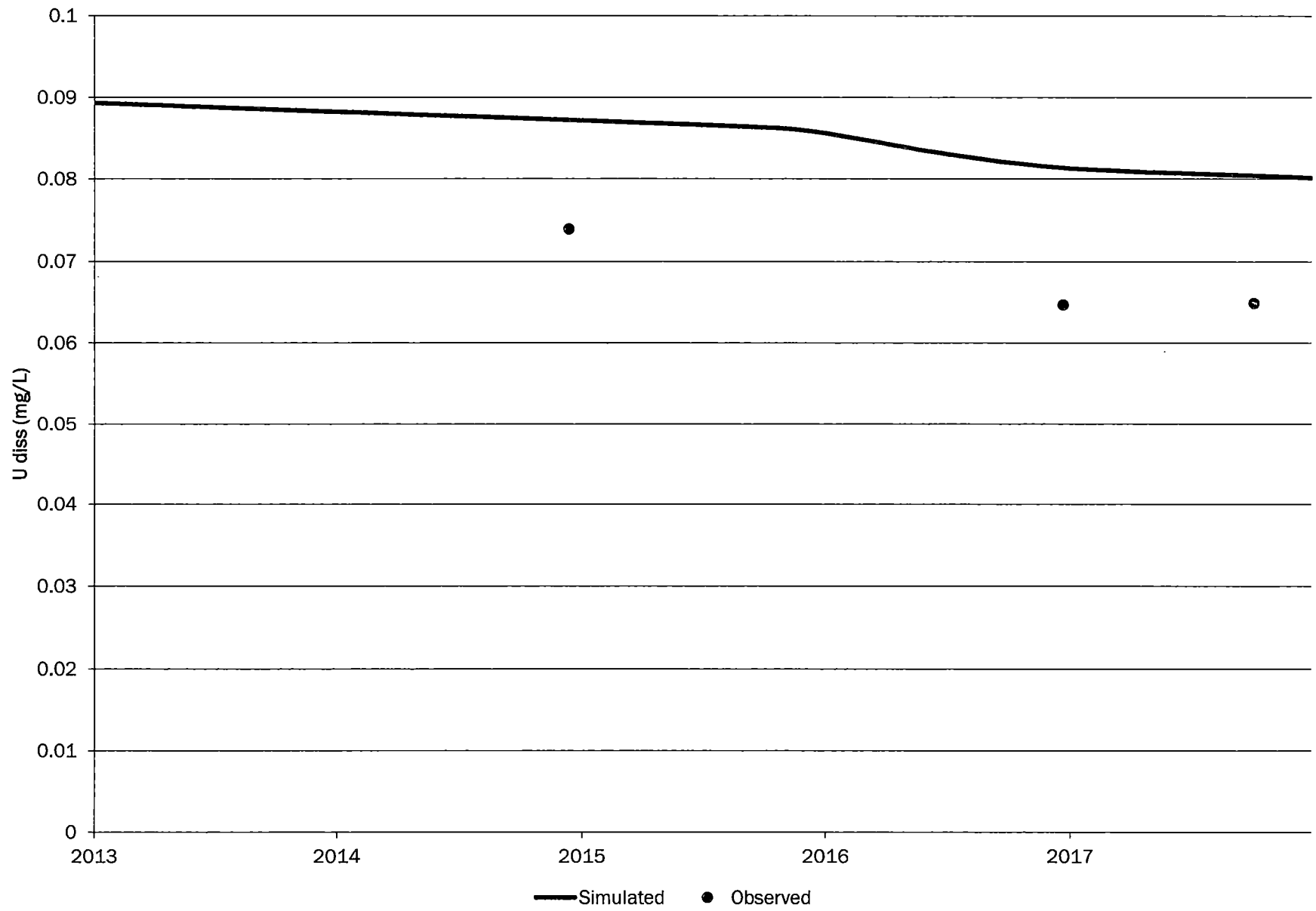
0634-AI



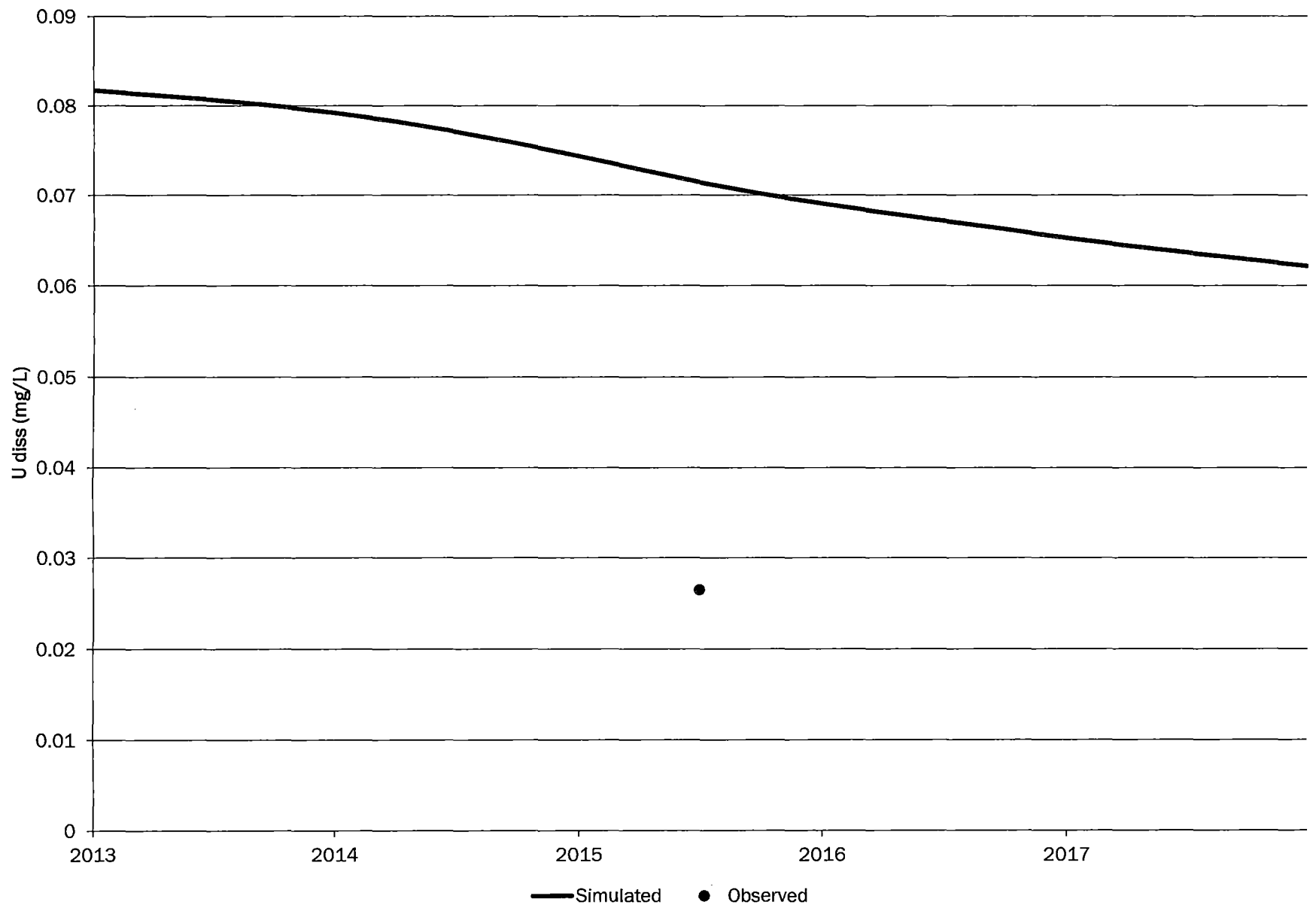
0636-AI



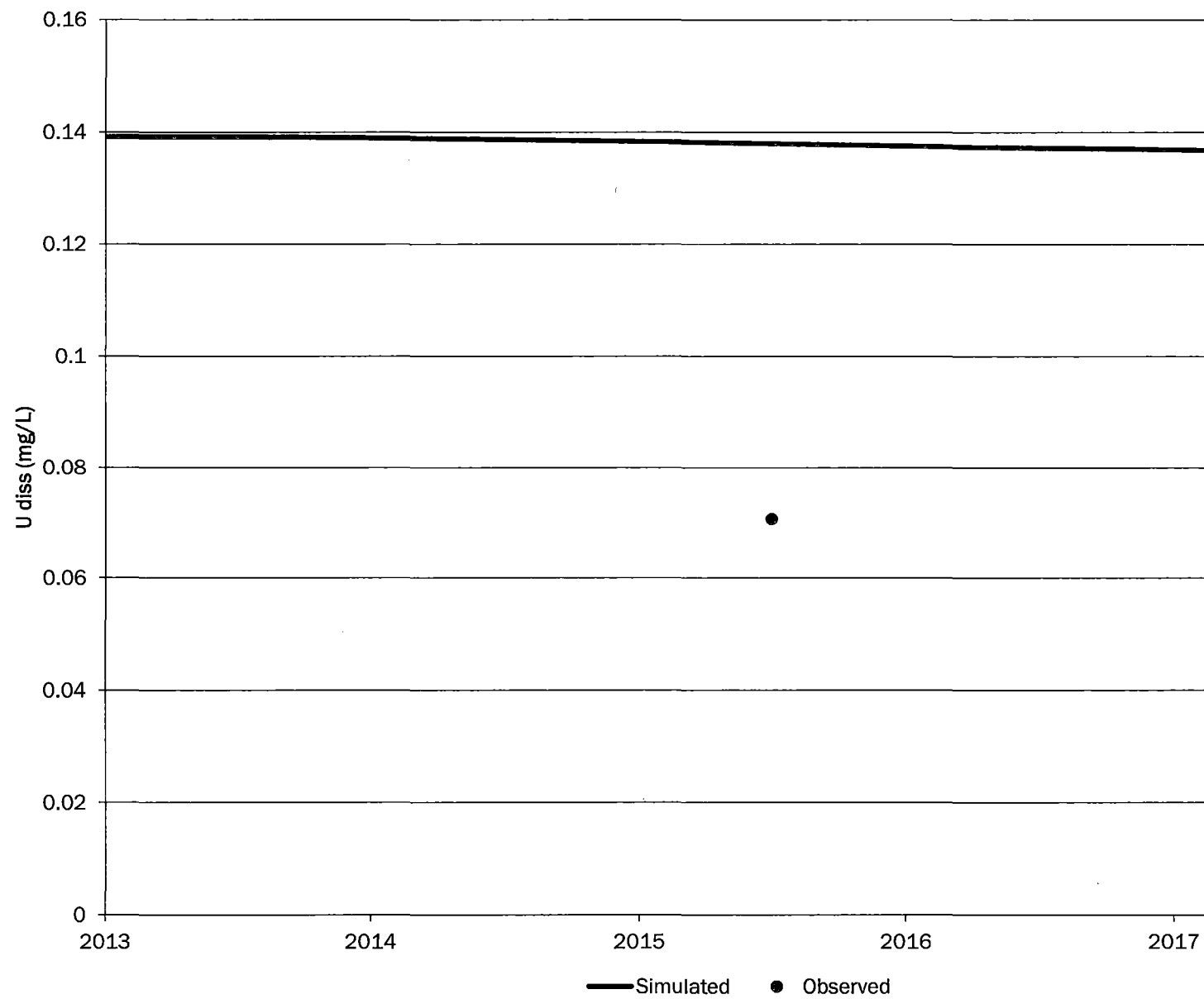
0637-AI



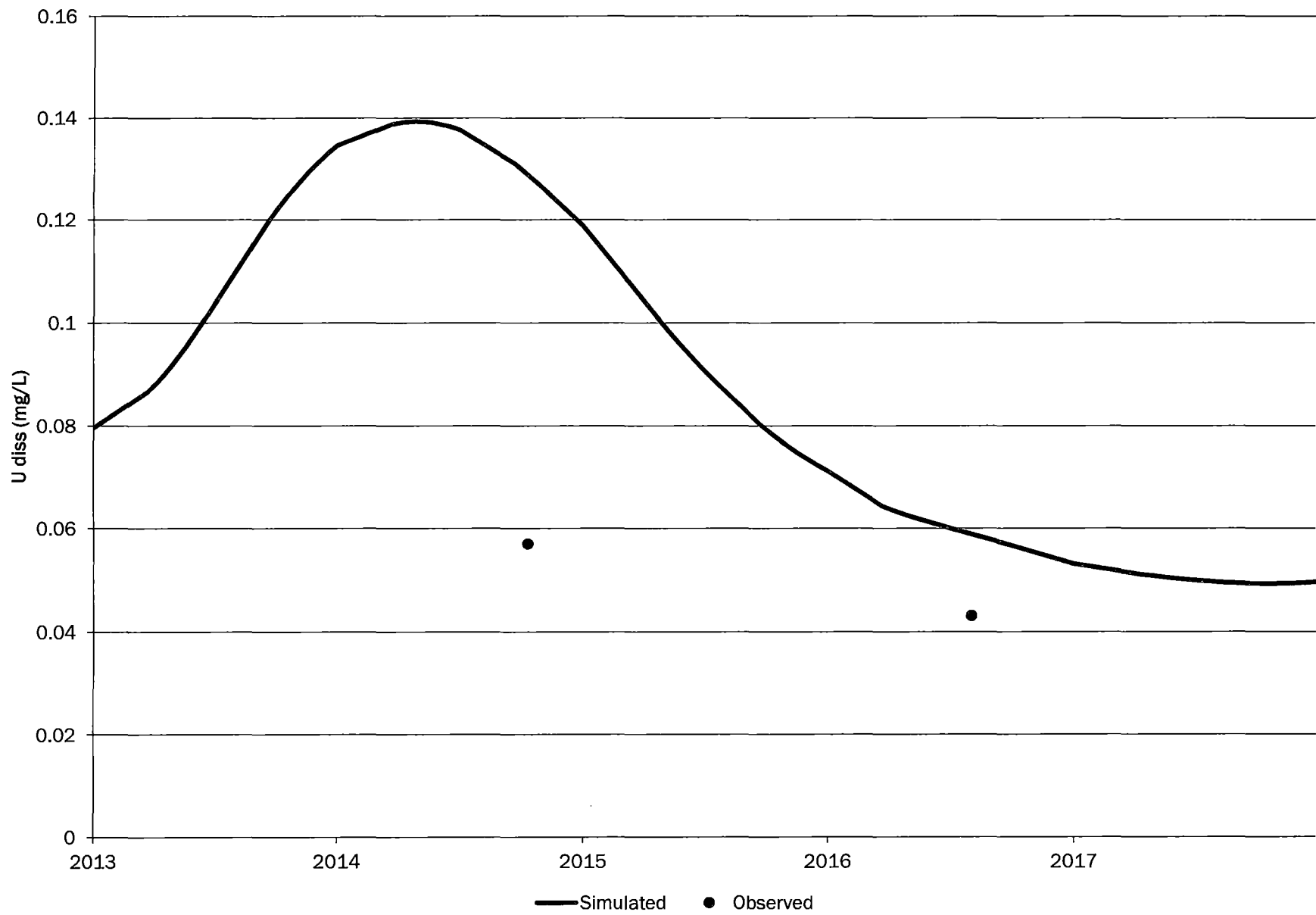
0641-AI



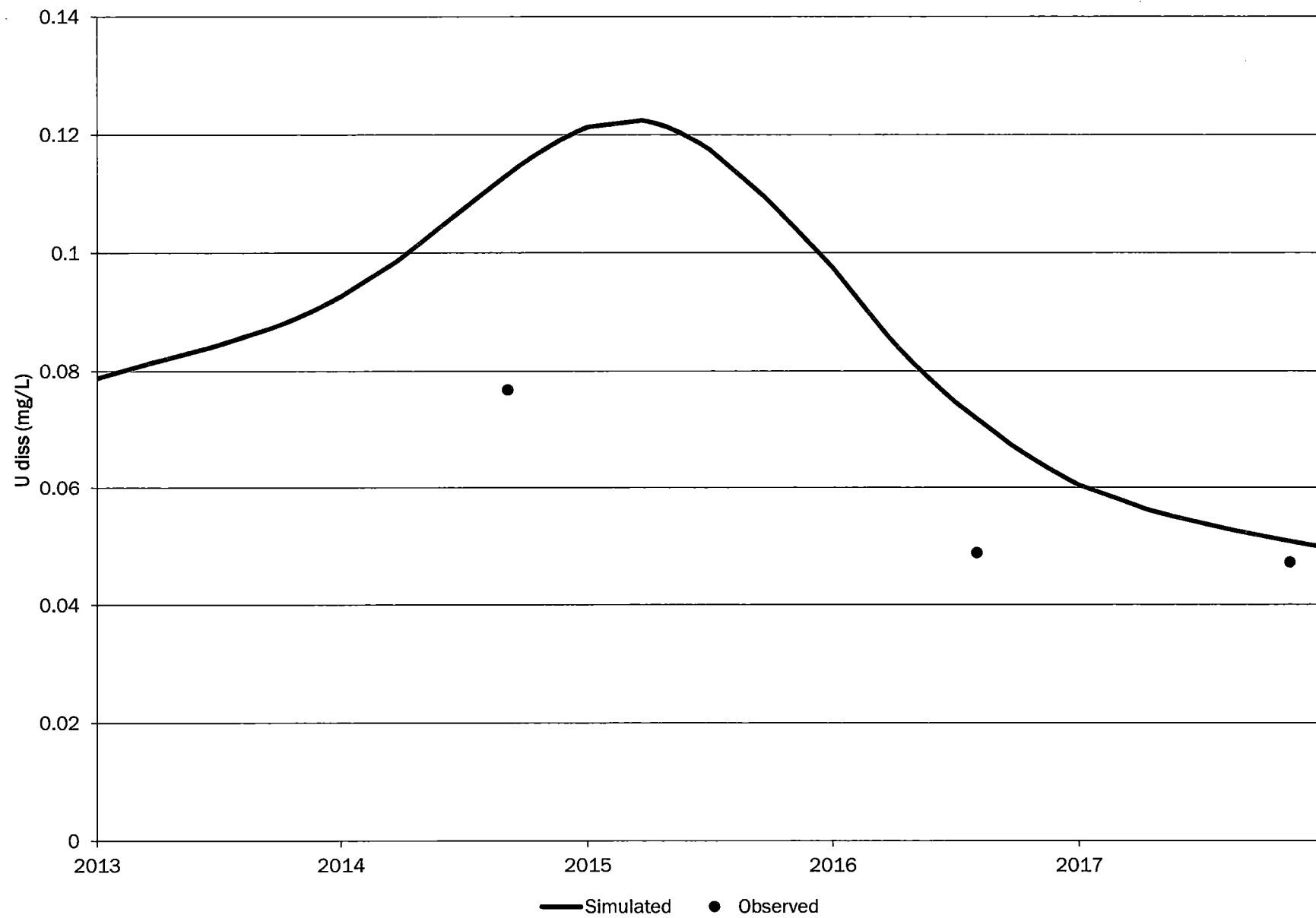
0642-AI



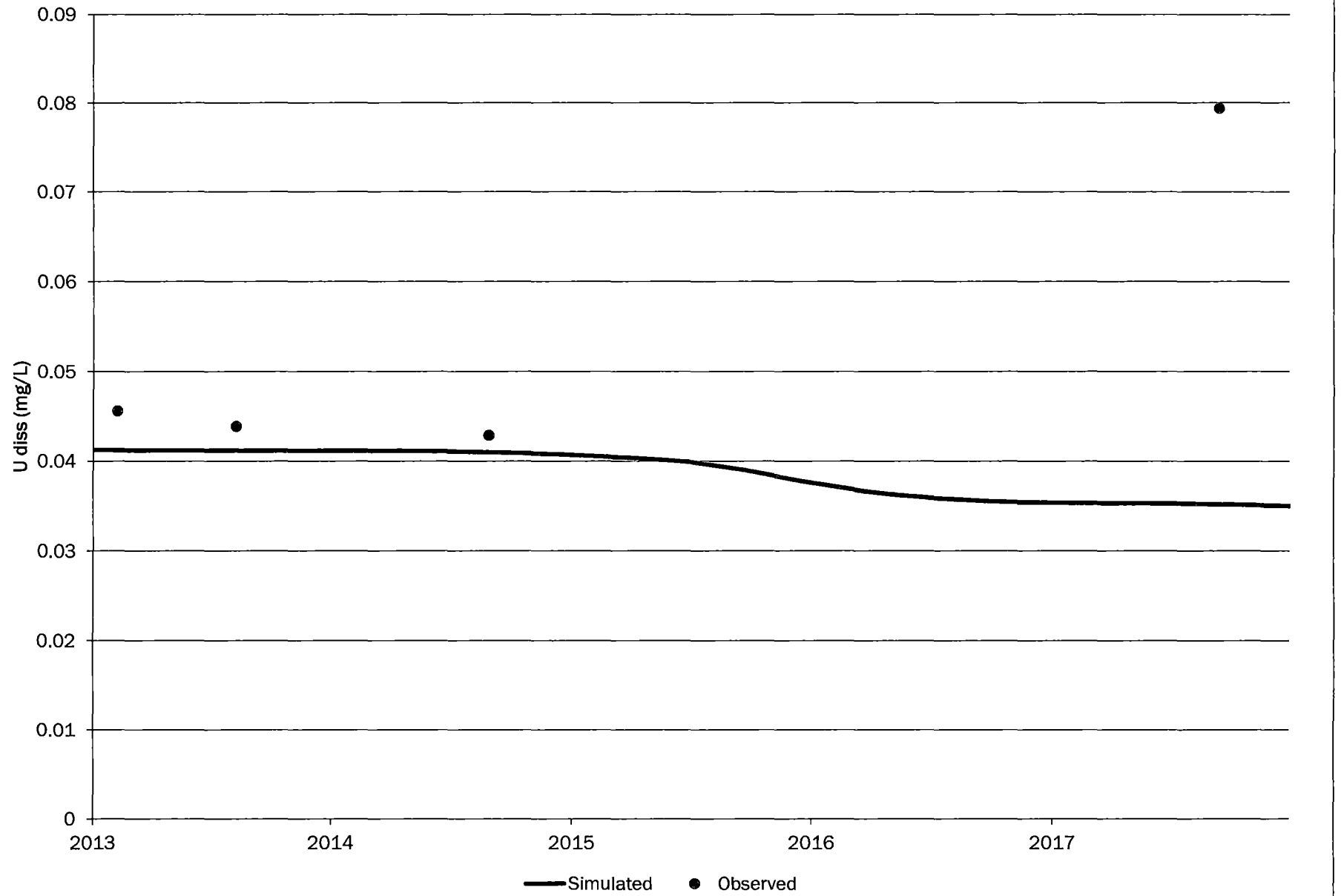
0644-AI



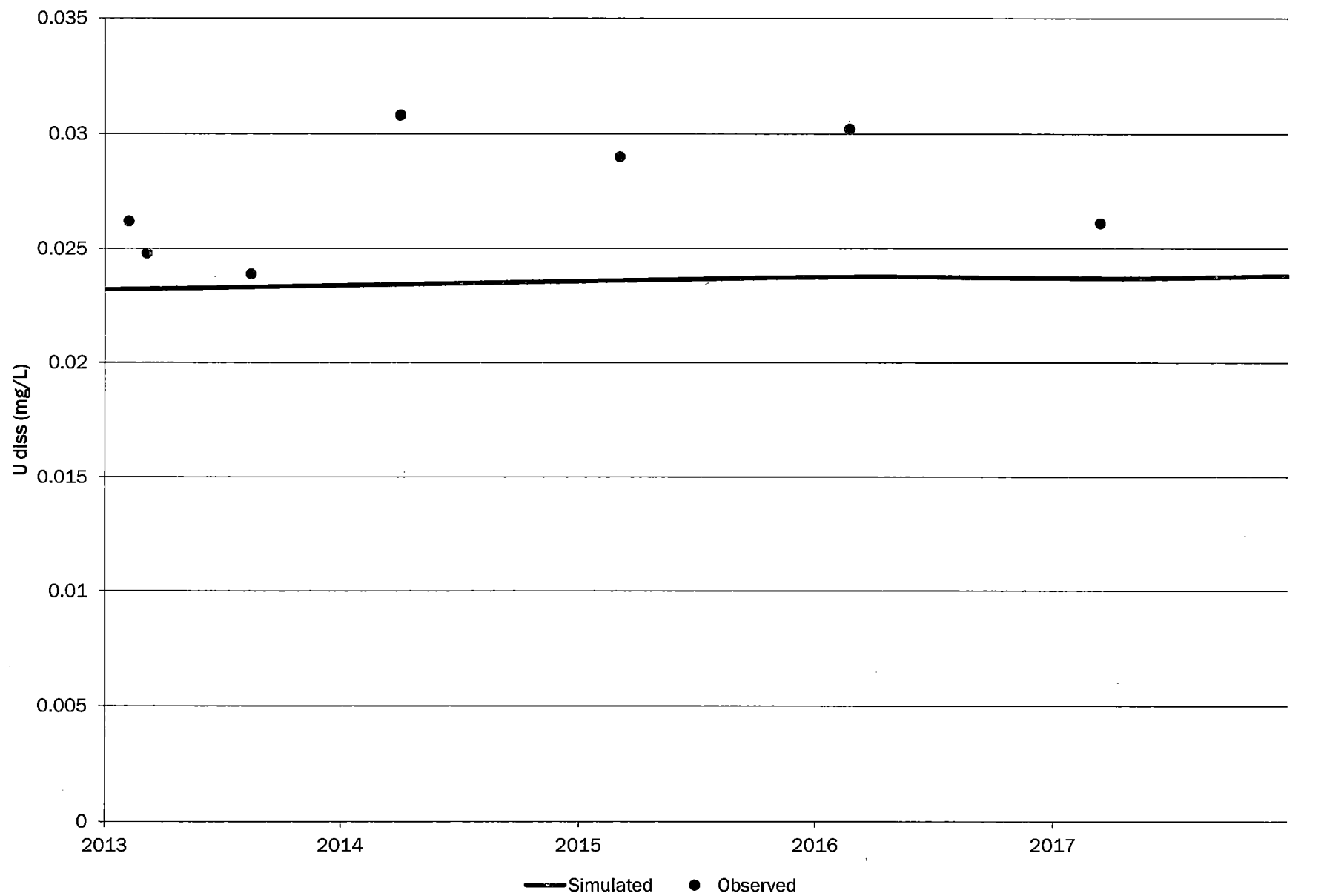
0646-AI



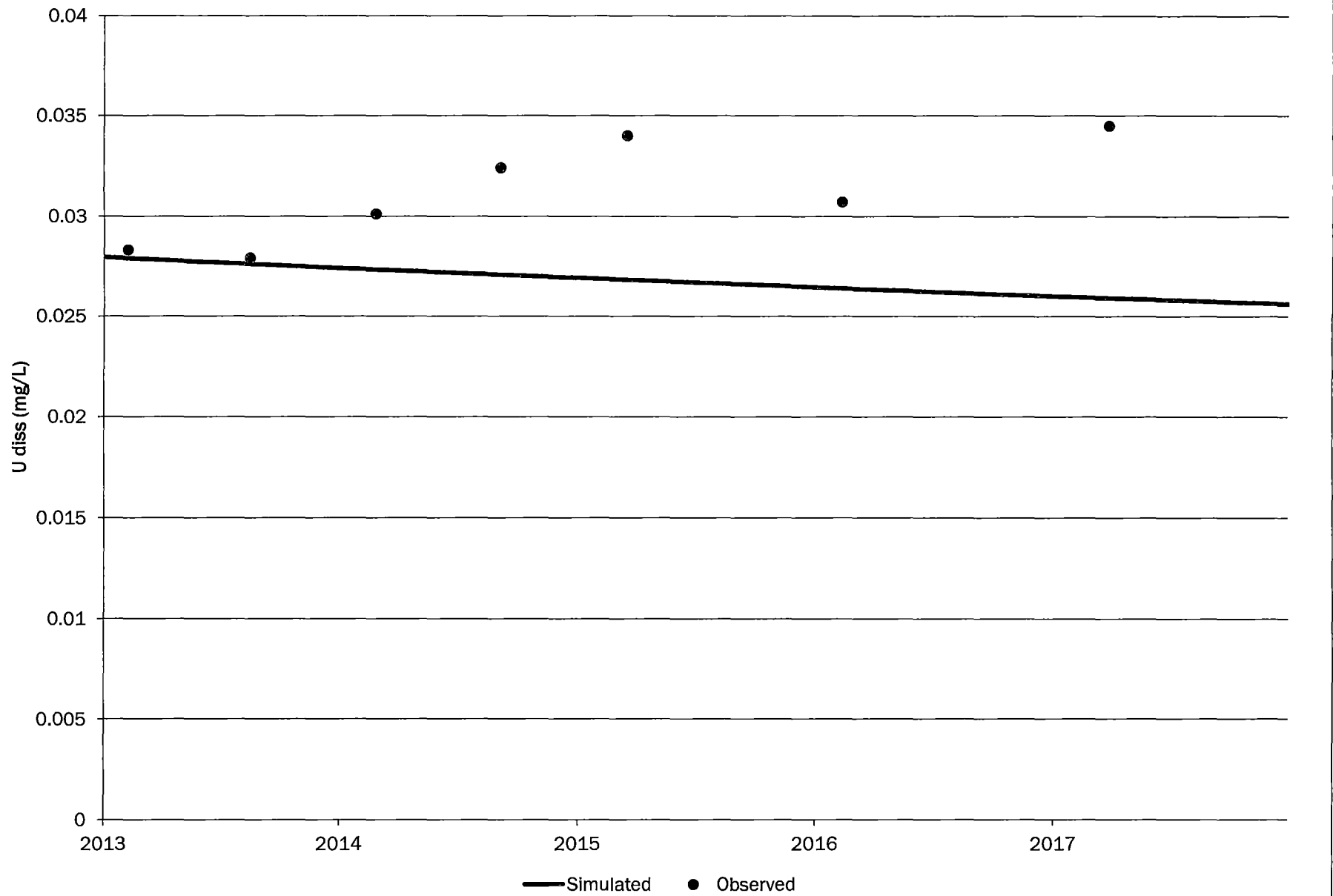
0647-AI



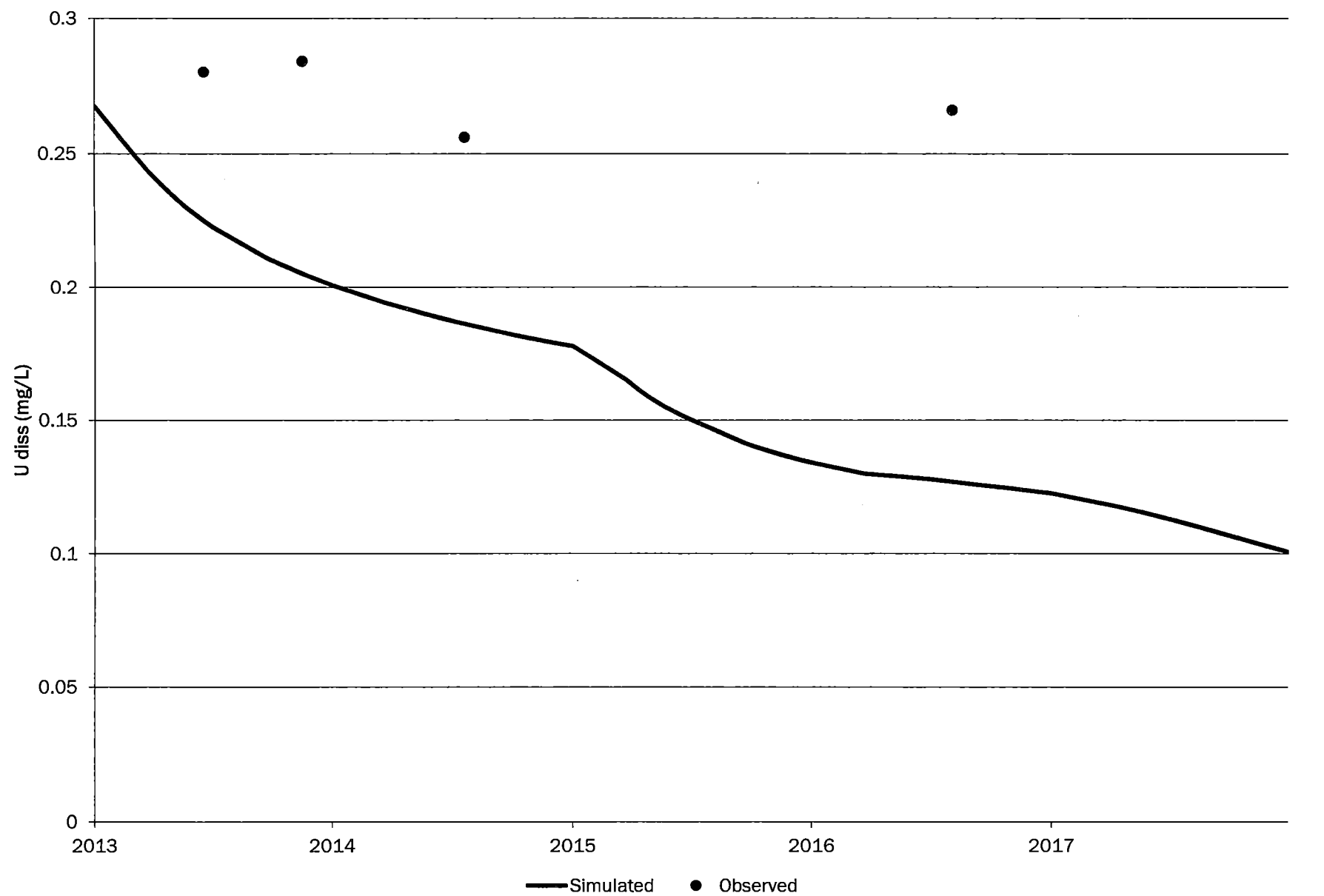
0649-AI



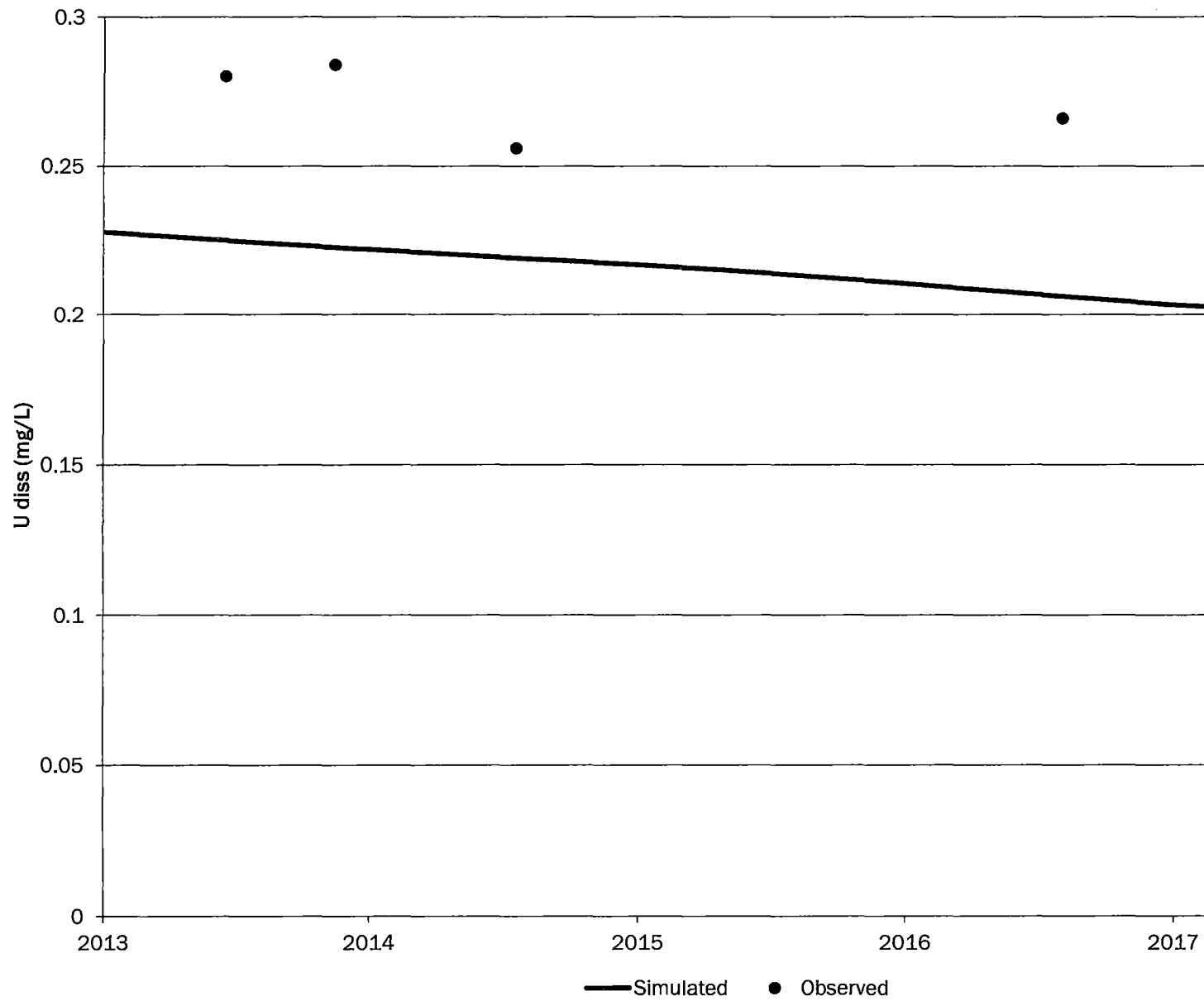
0650-AI



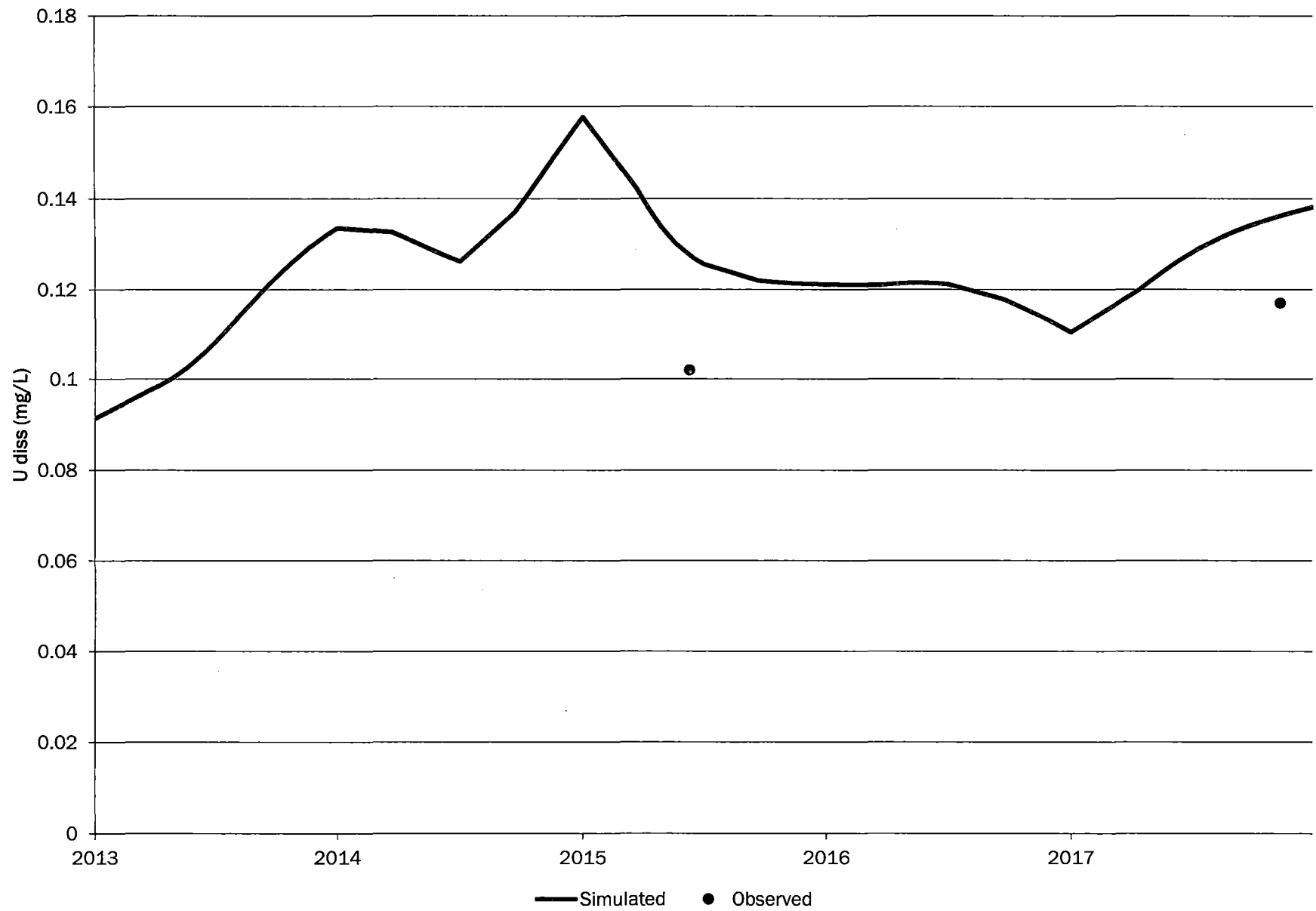
0653-AI



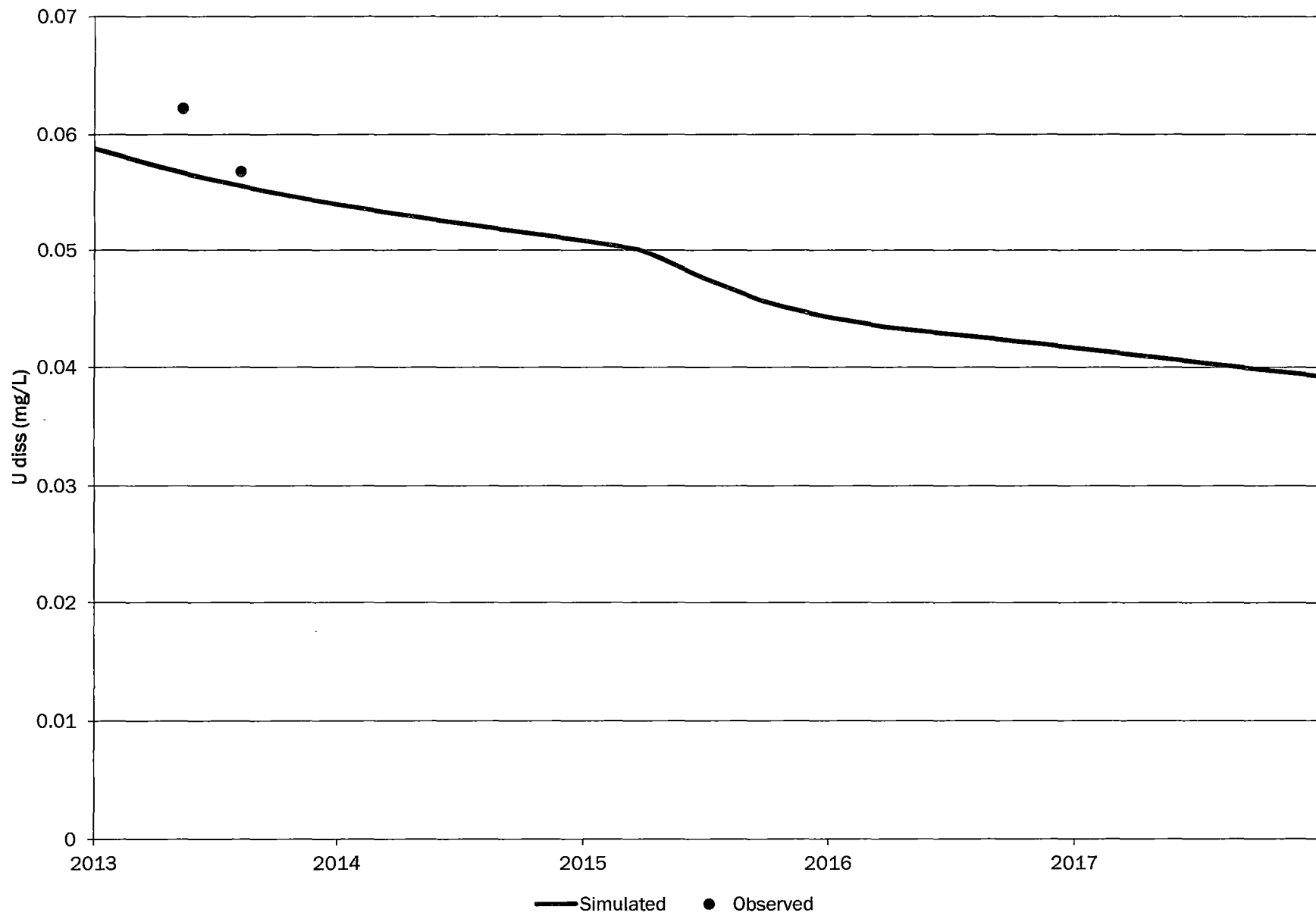
0653-LC



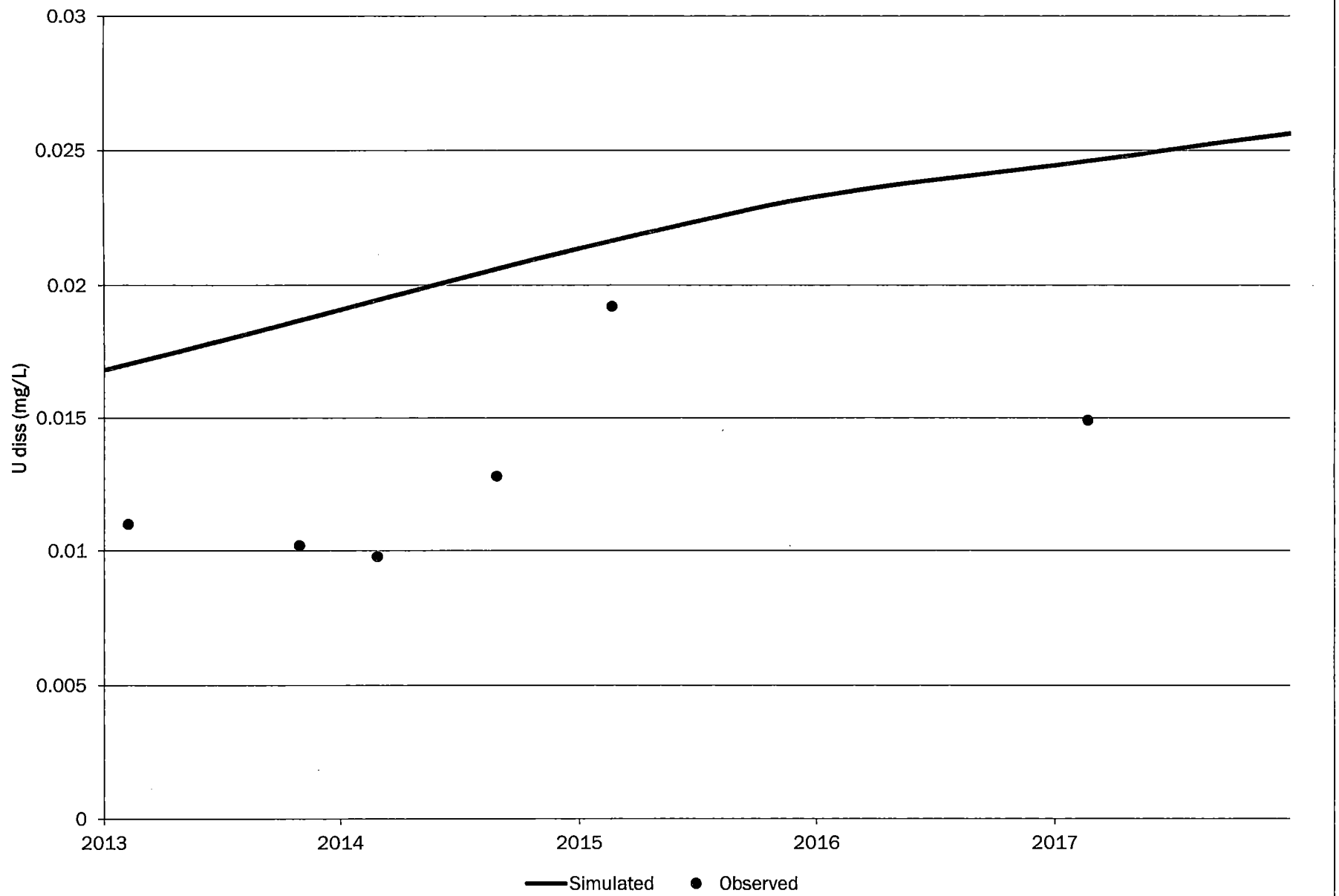
0654-AI



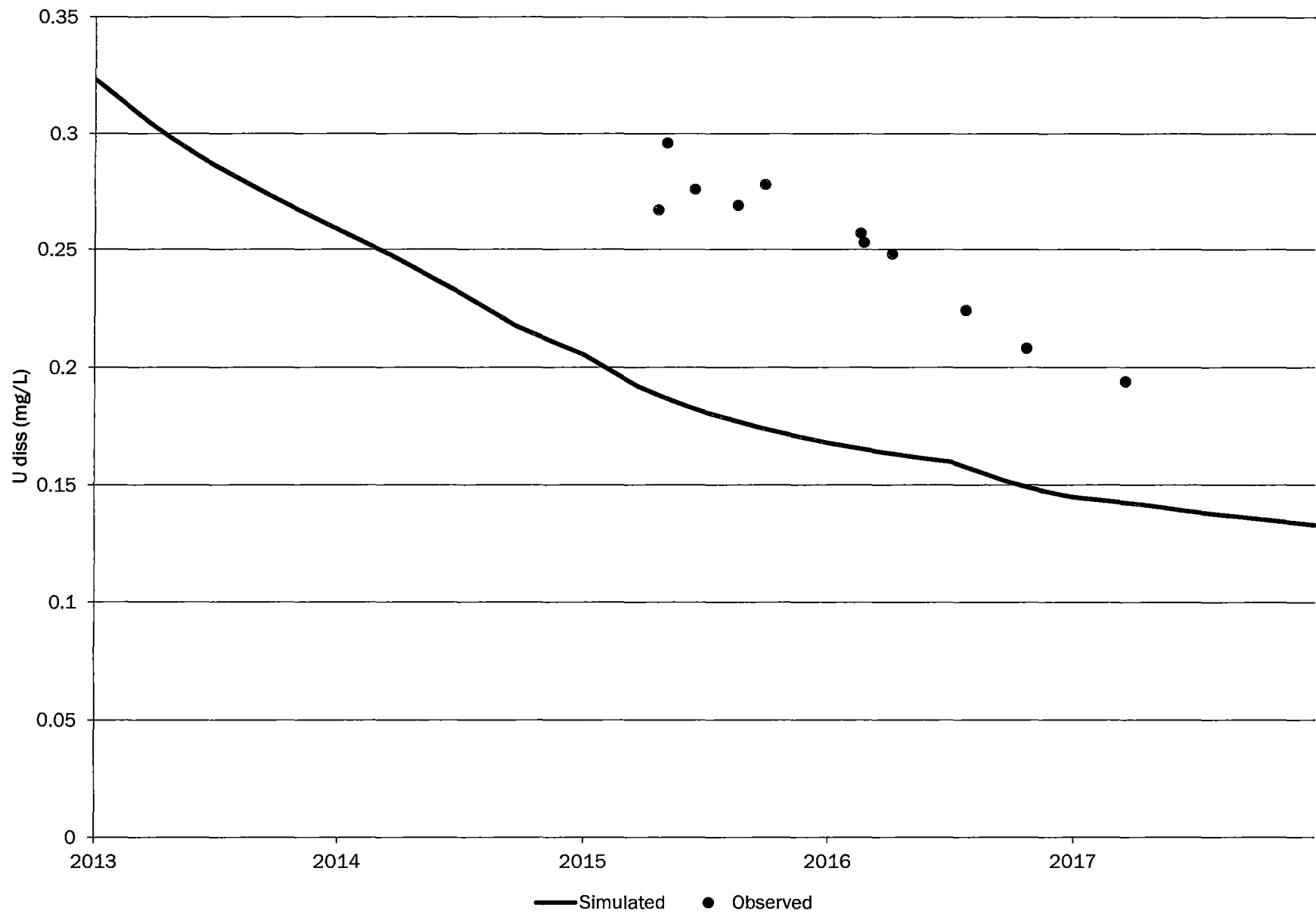
0657-AI



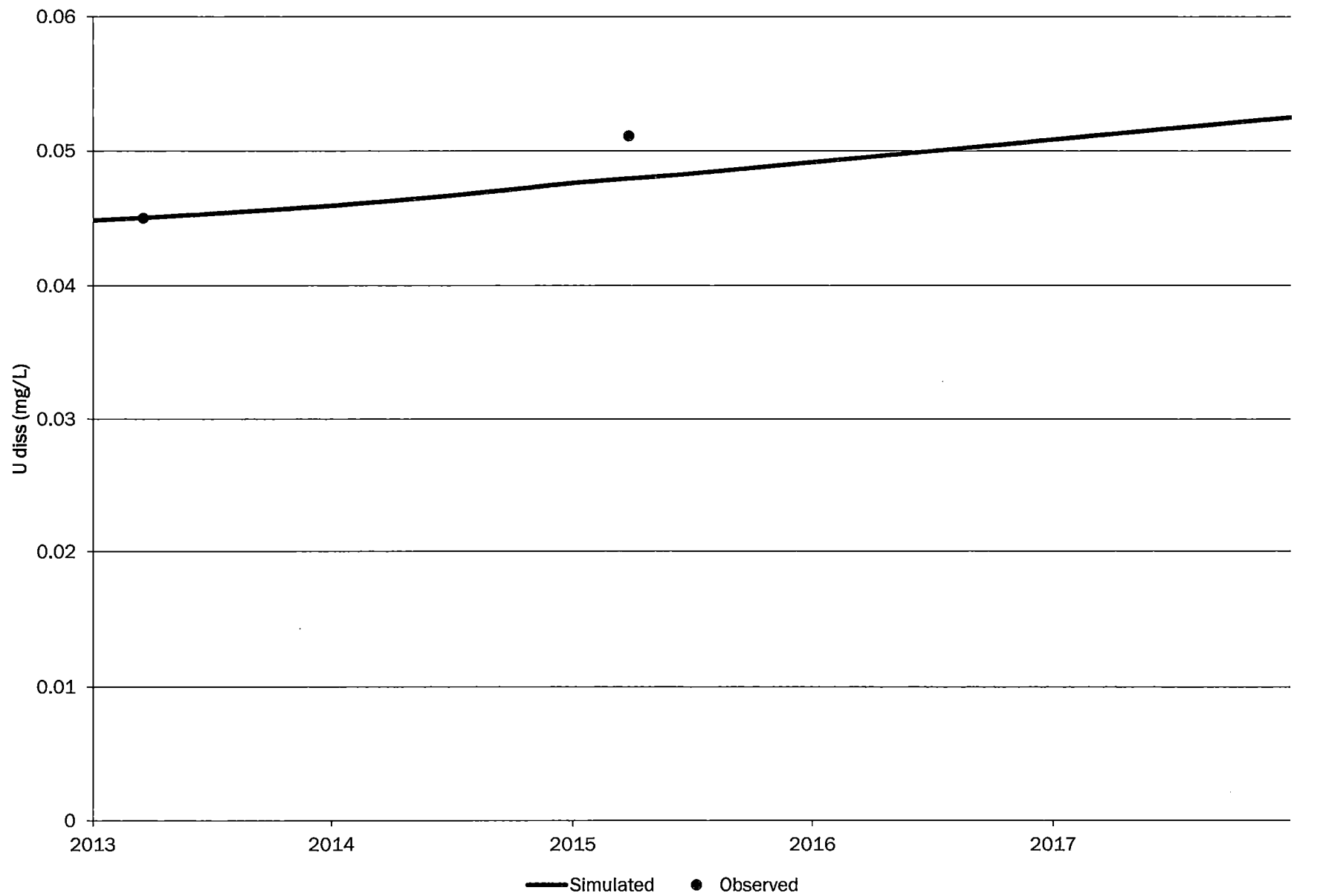
0658-AI



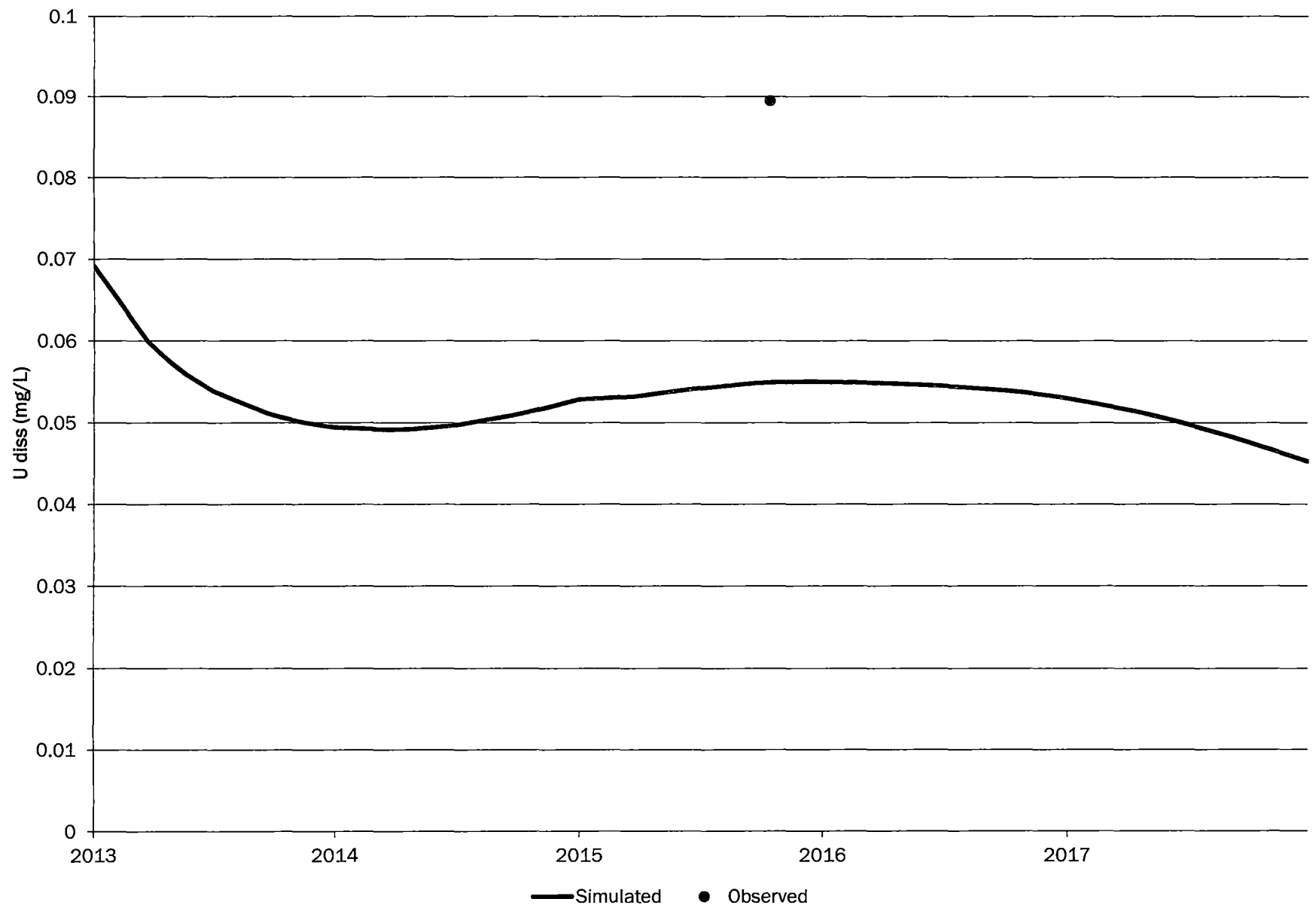
0659-AI



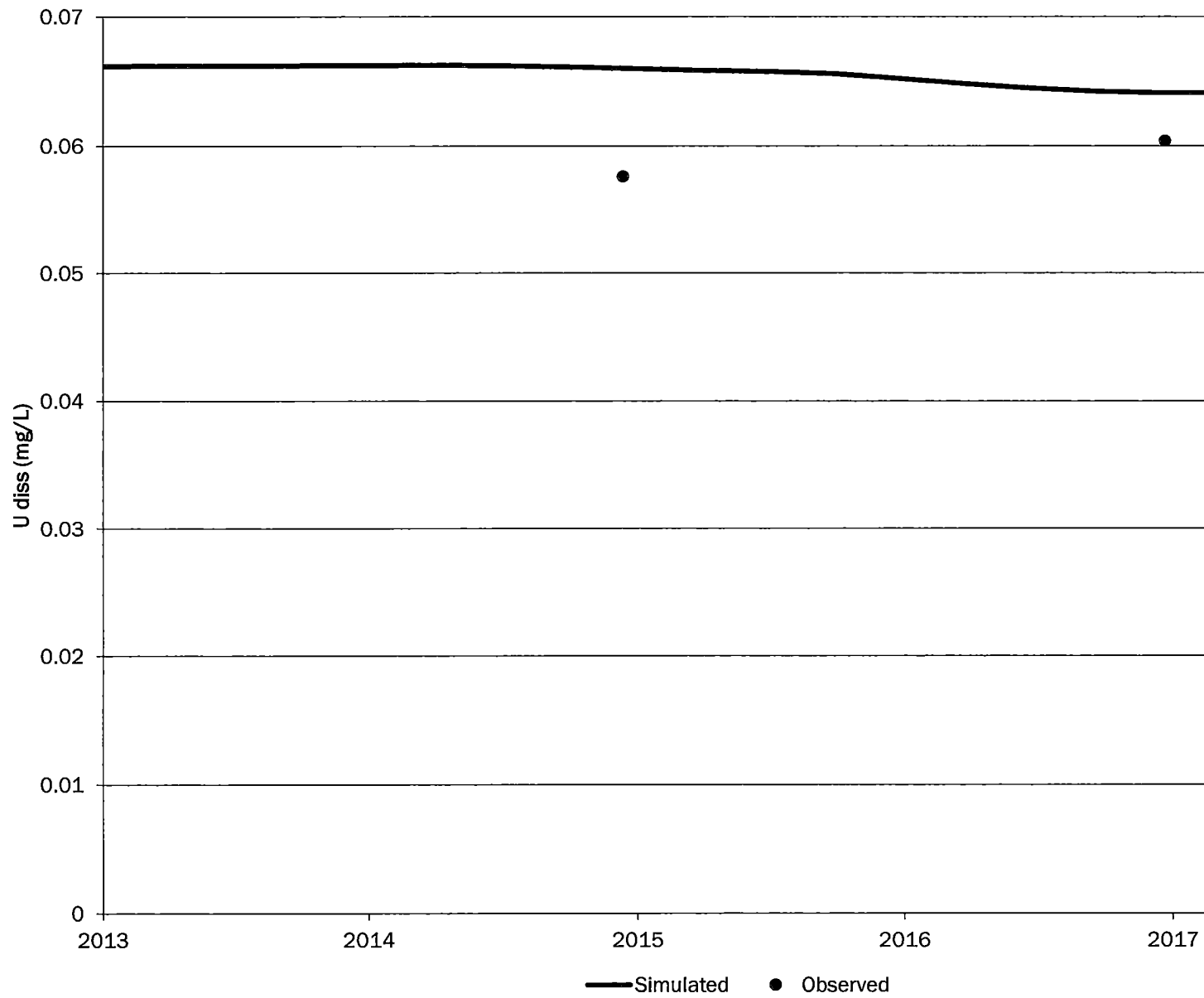
0681-AI



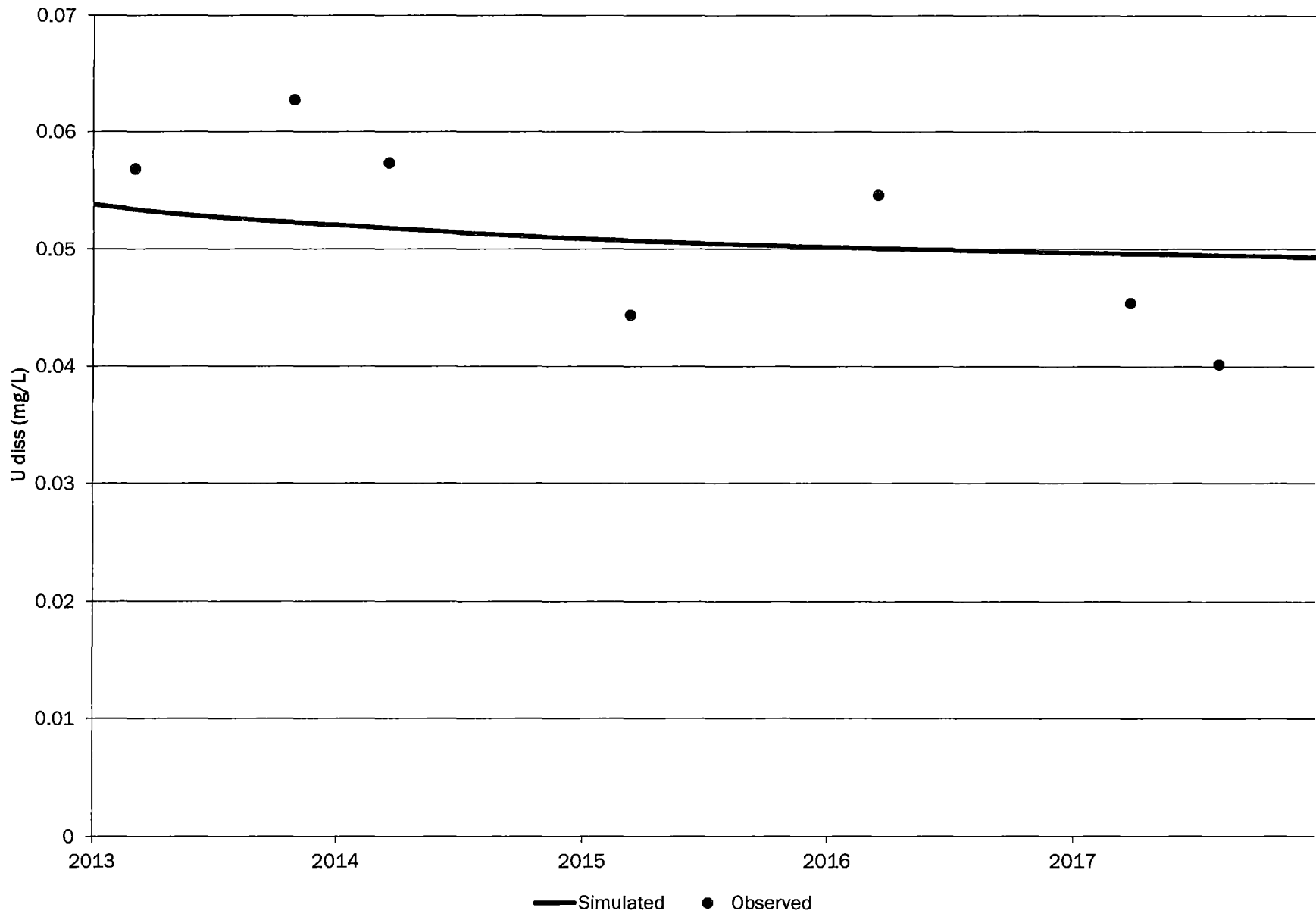
0684-AI



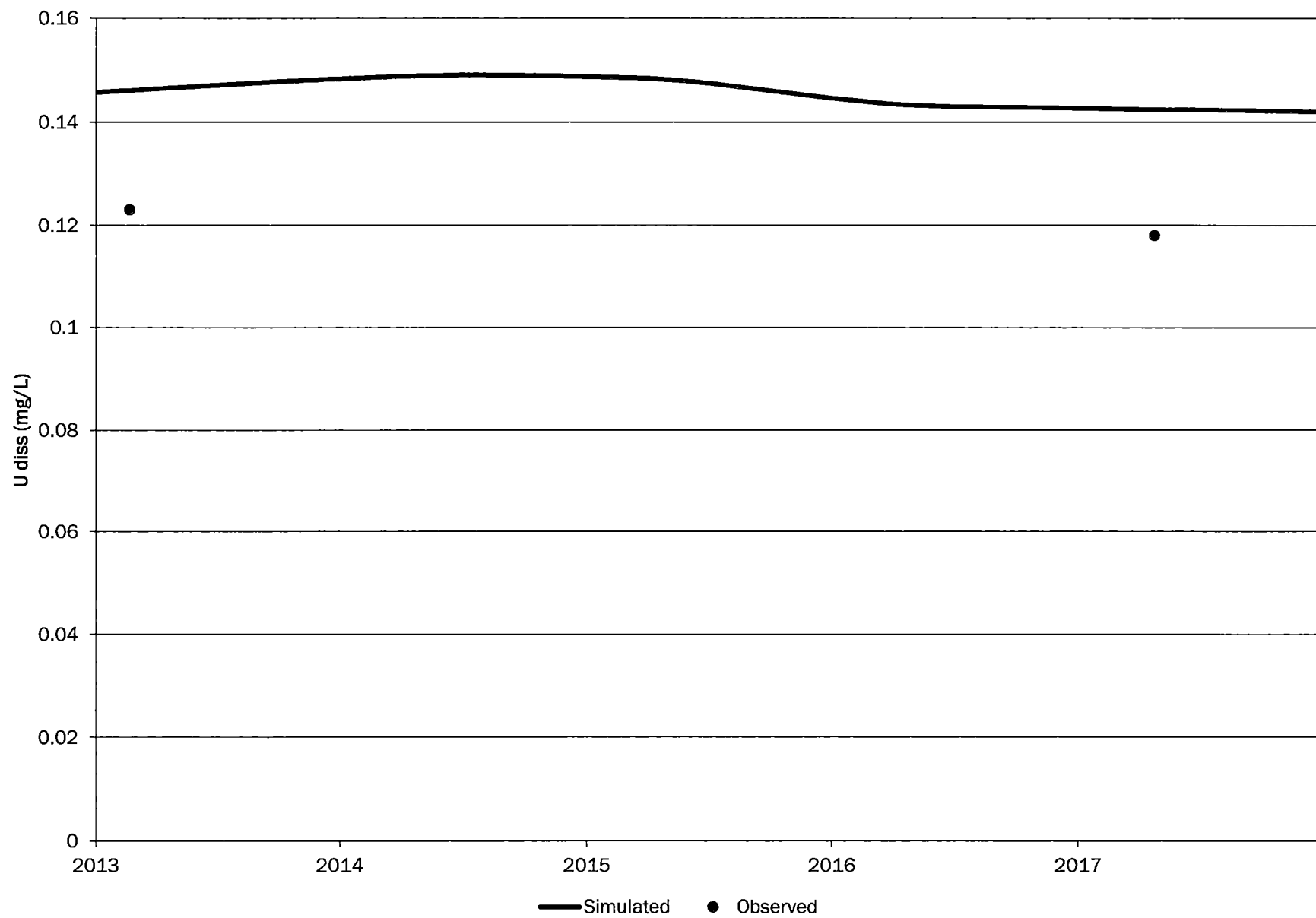
0686-AI



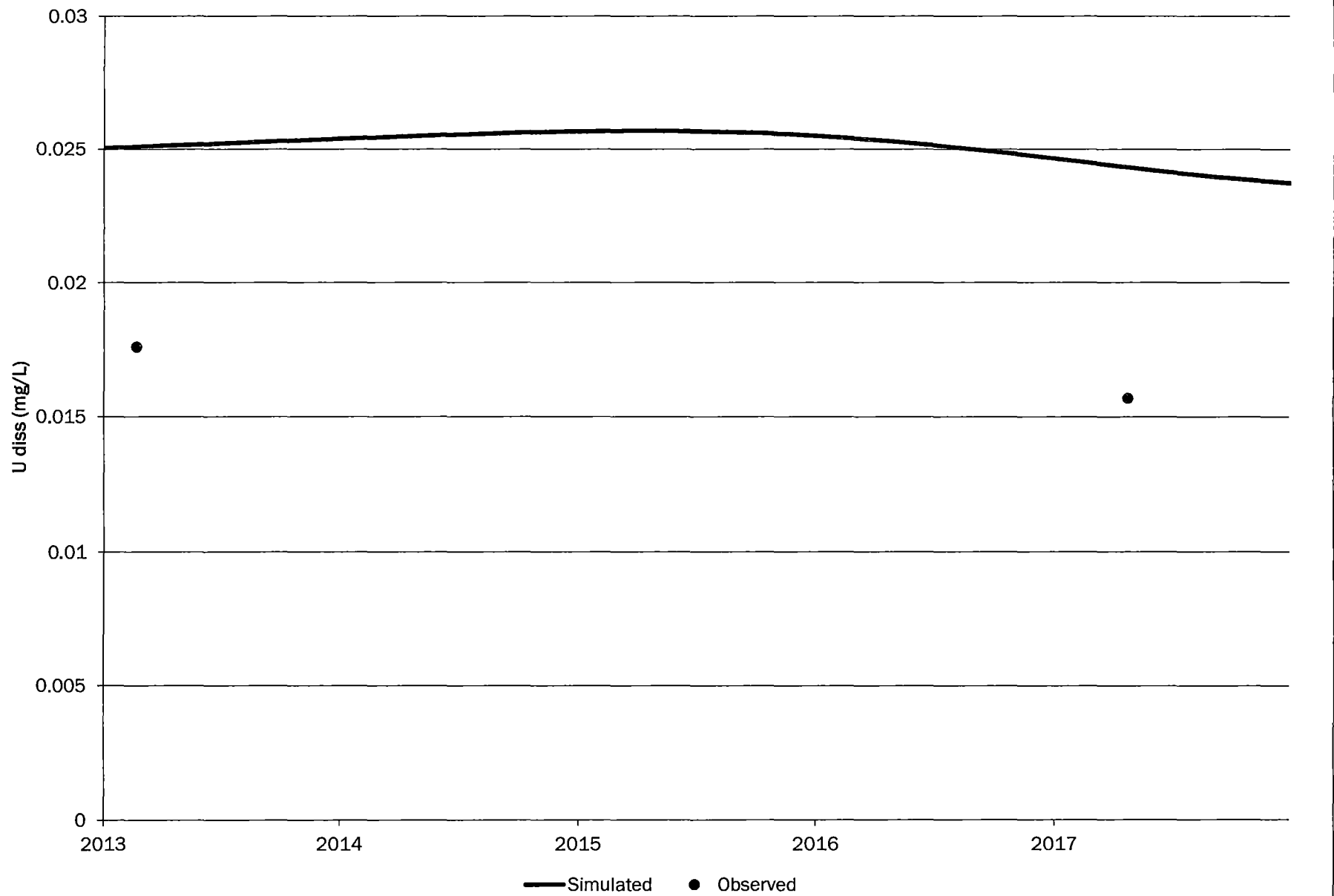
0688-AI



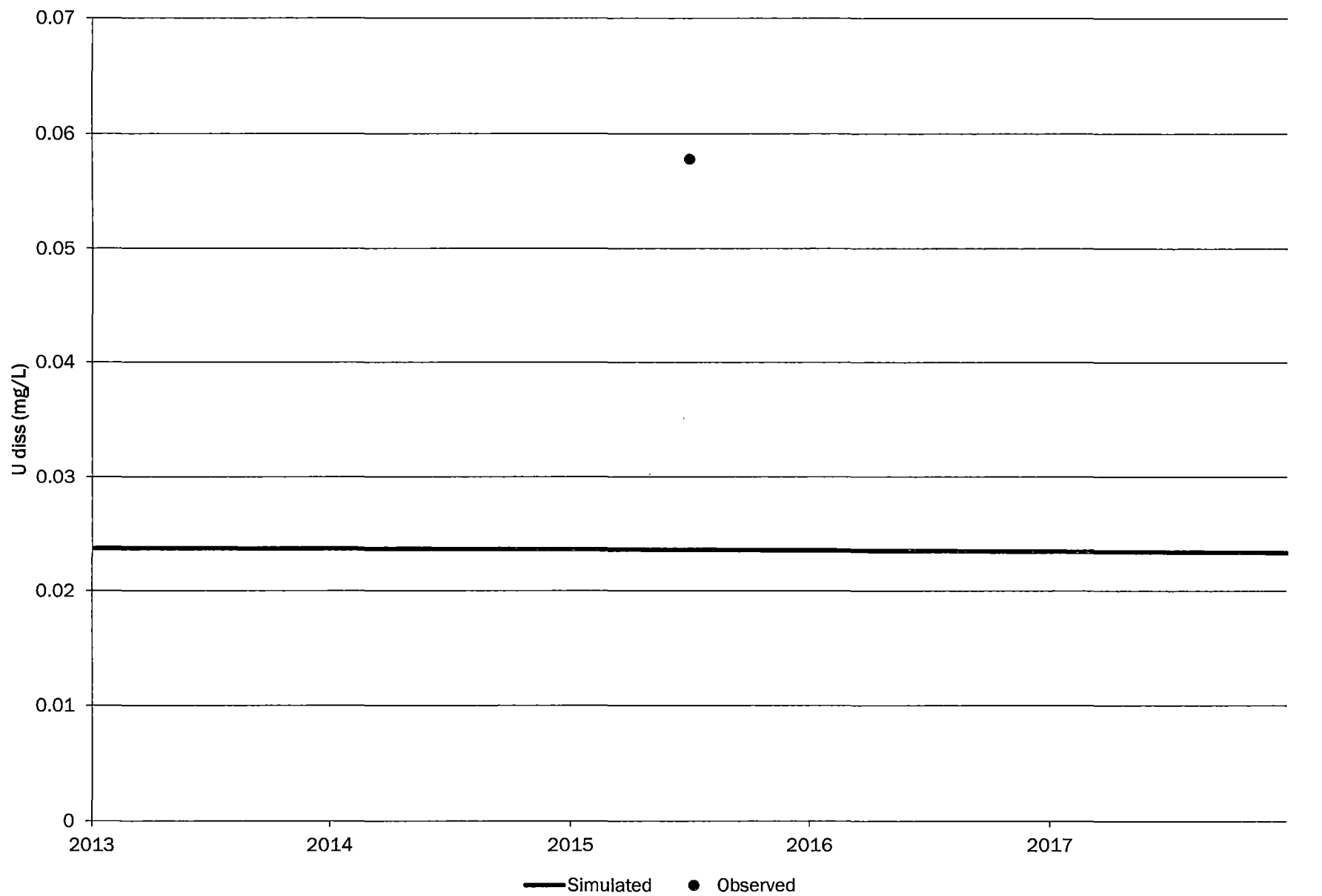
0690-AI



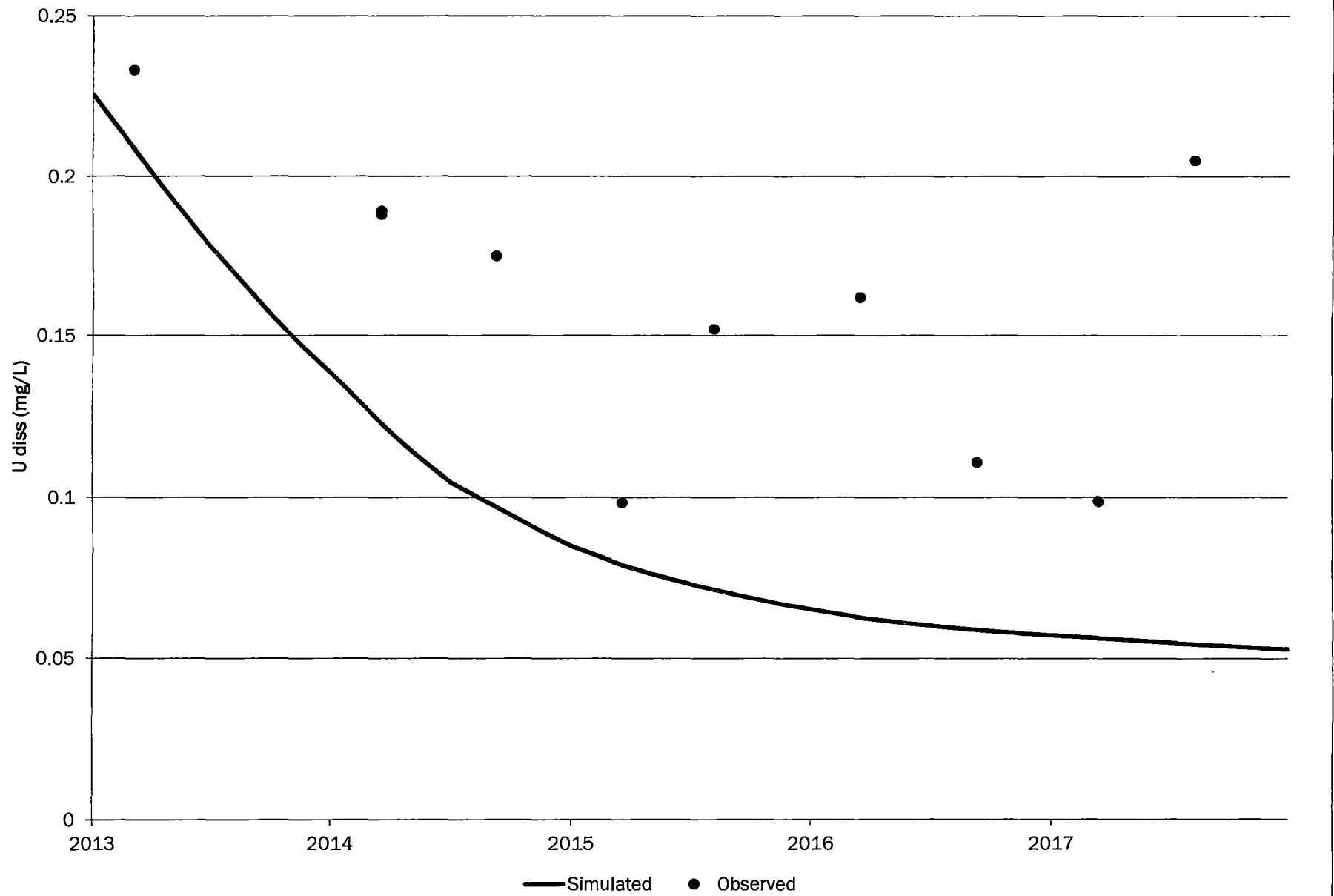
0691-AI



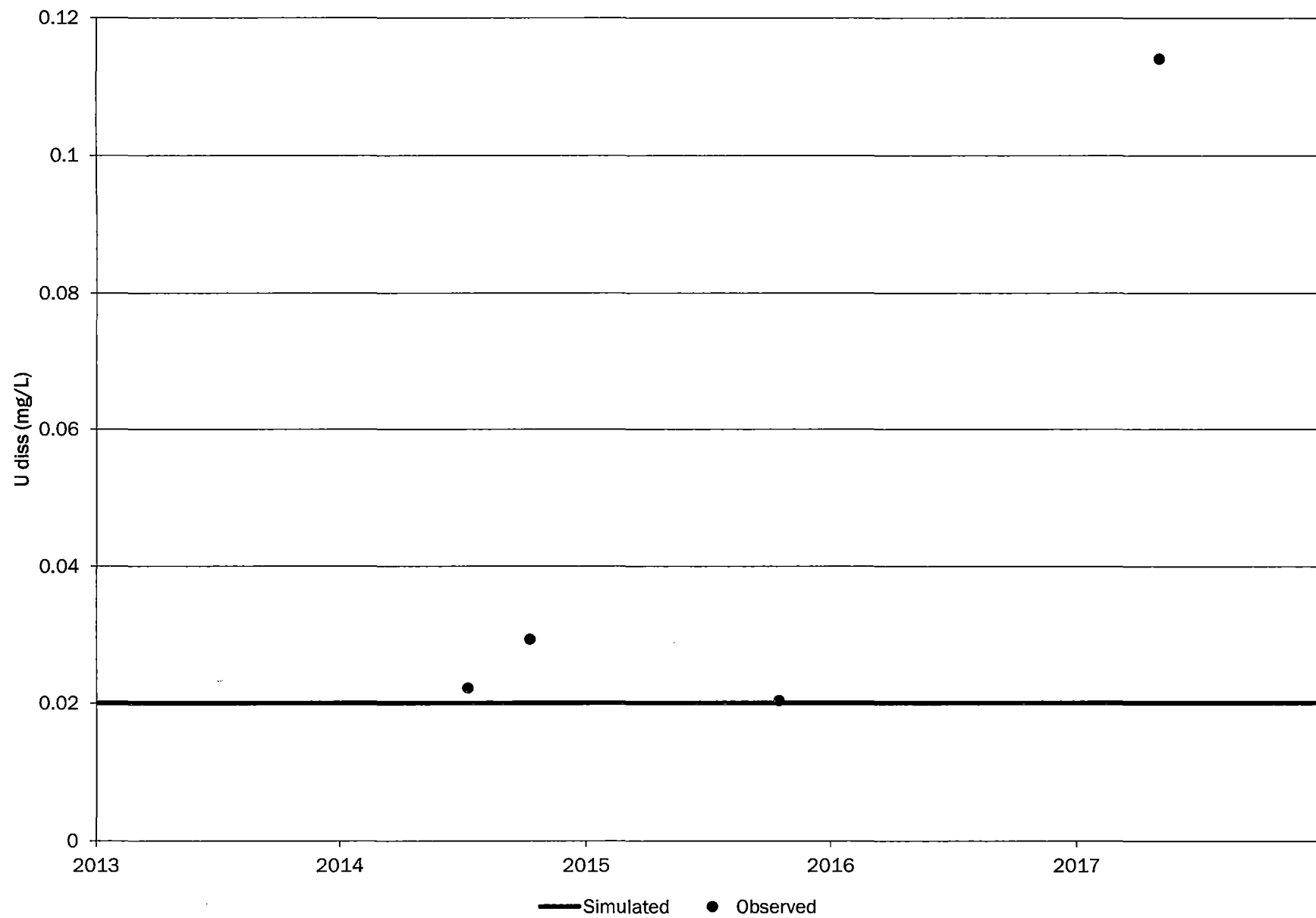
0692-AI



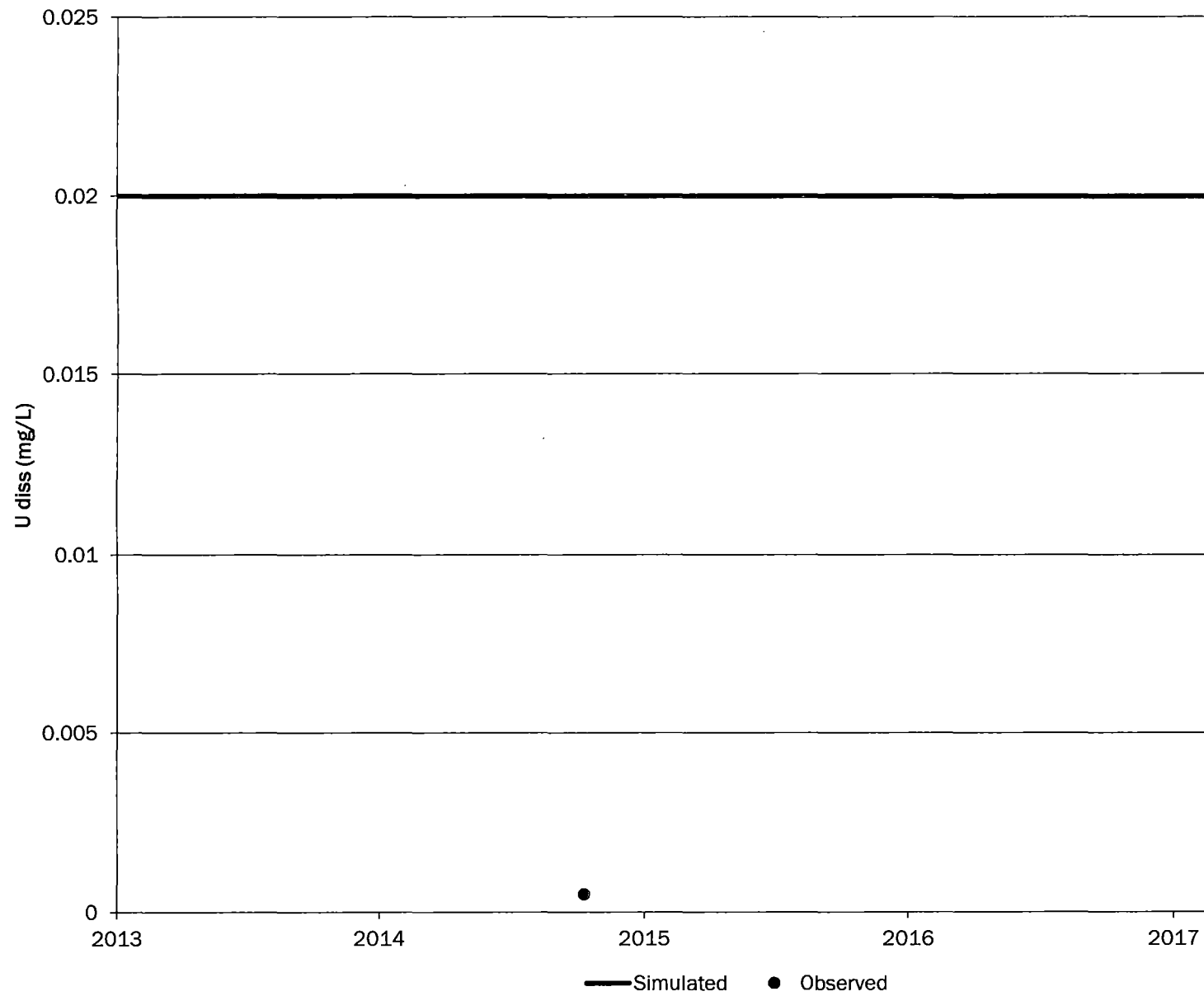
0802-AI



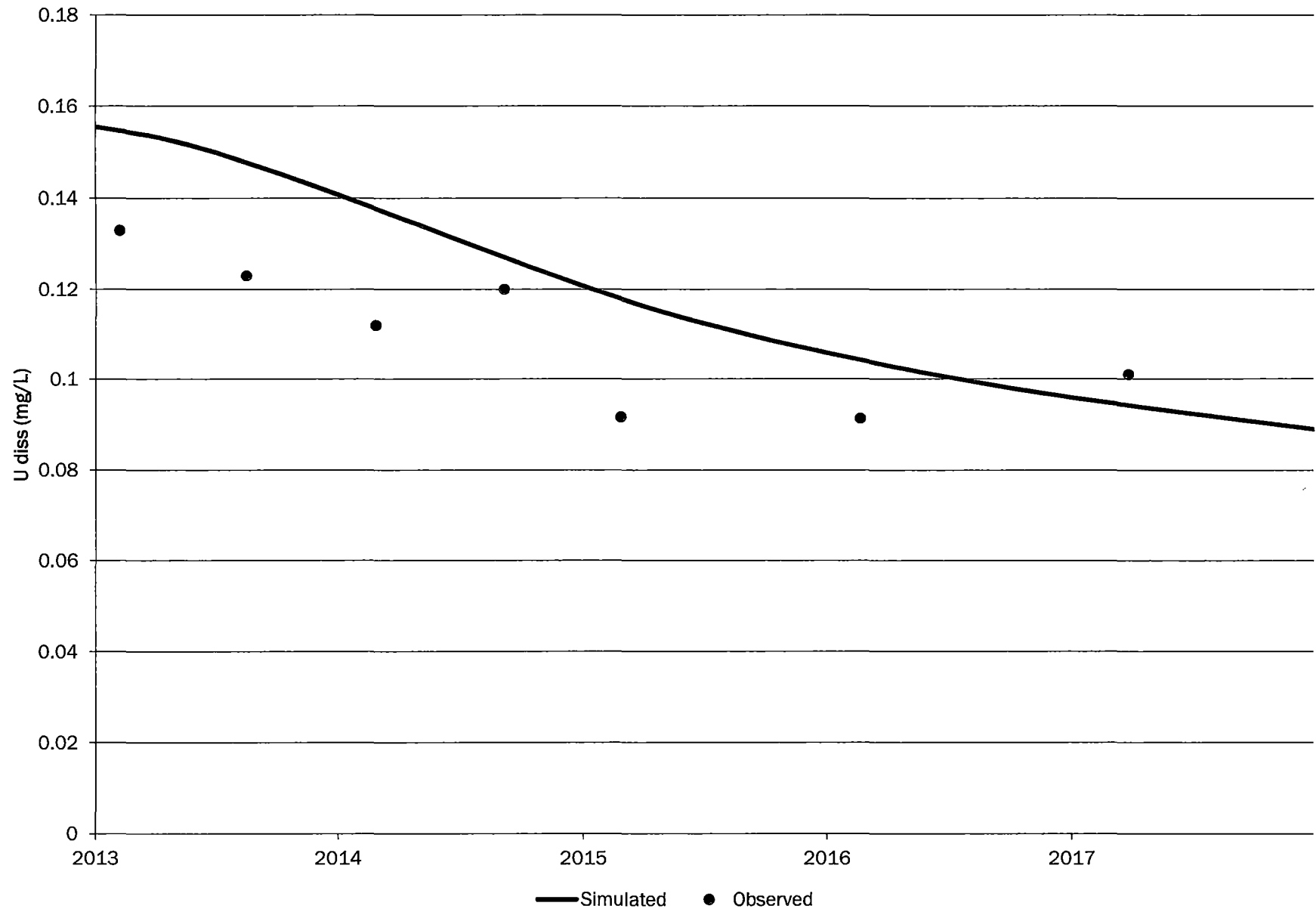
0806R-SA



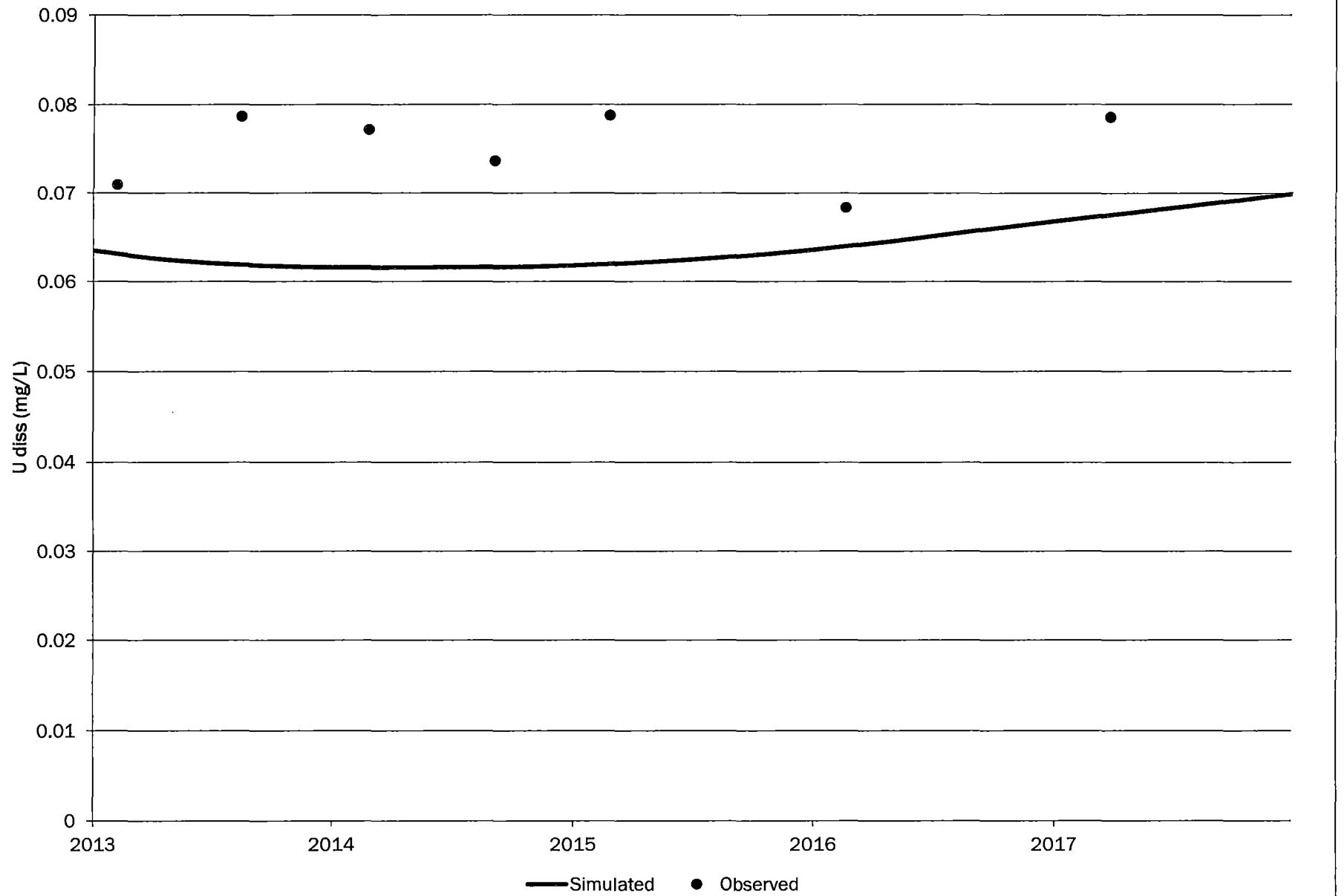
0806-SA



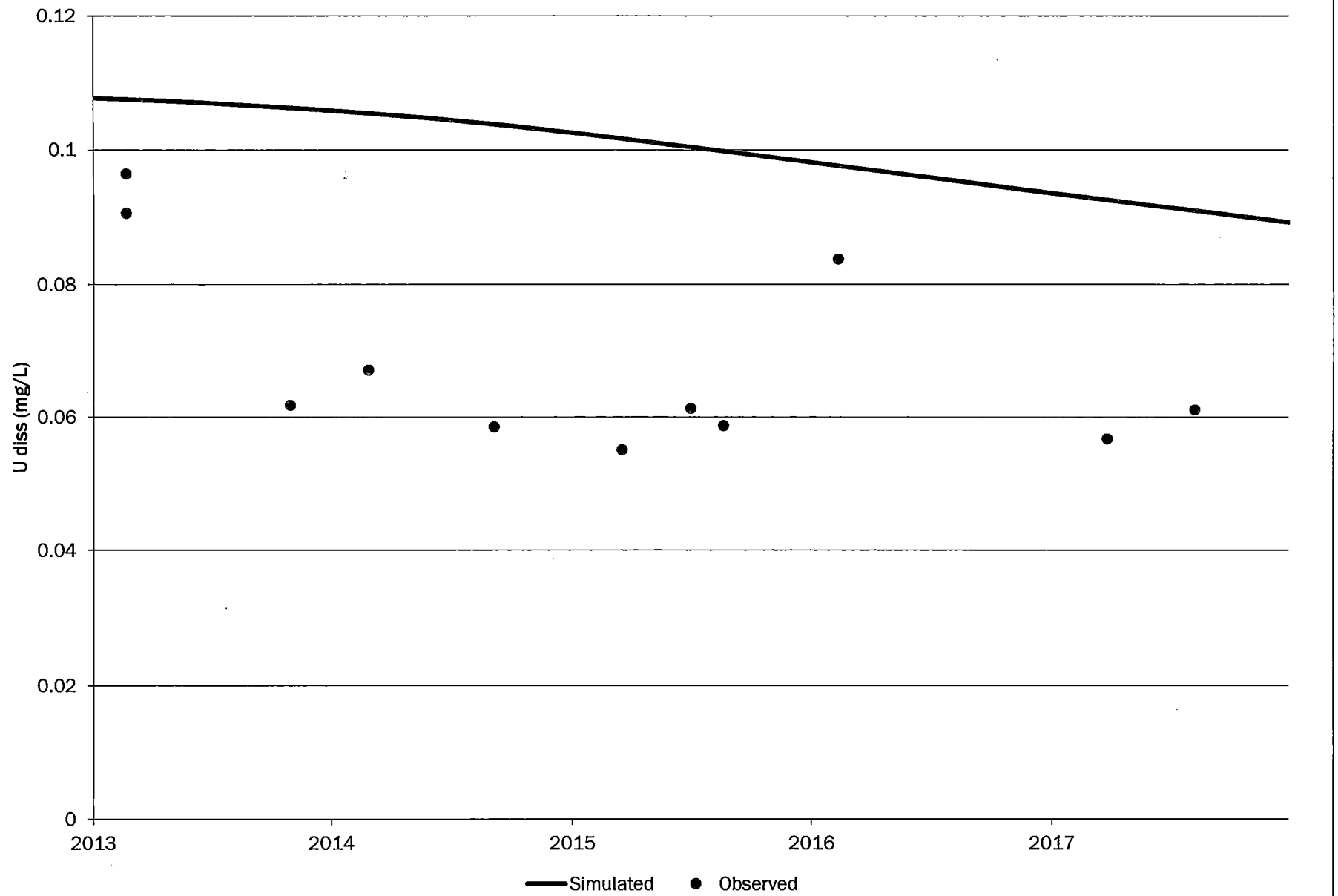
0844-AI



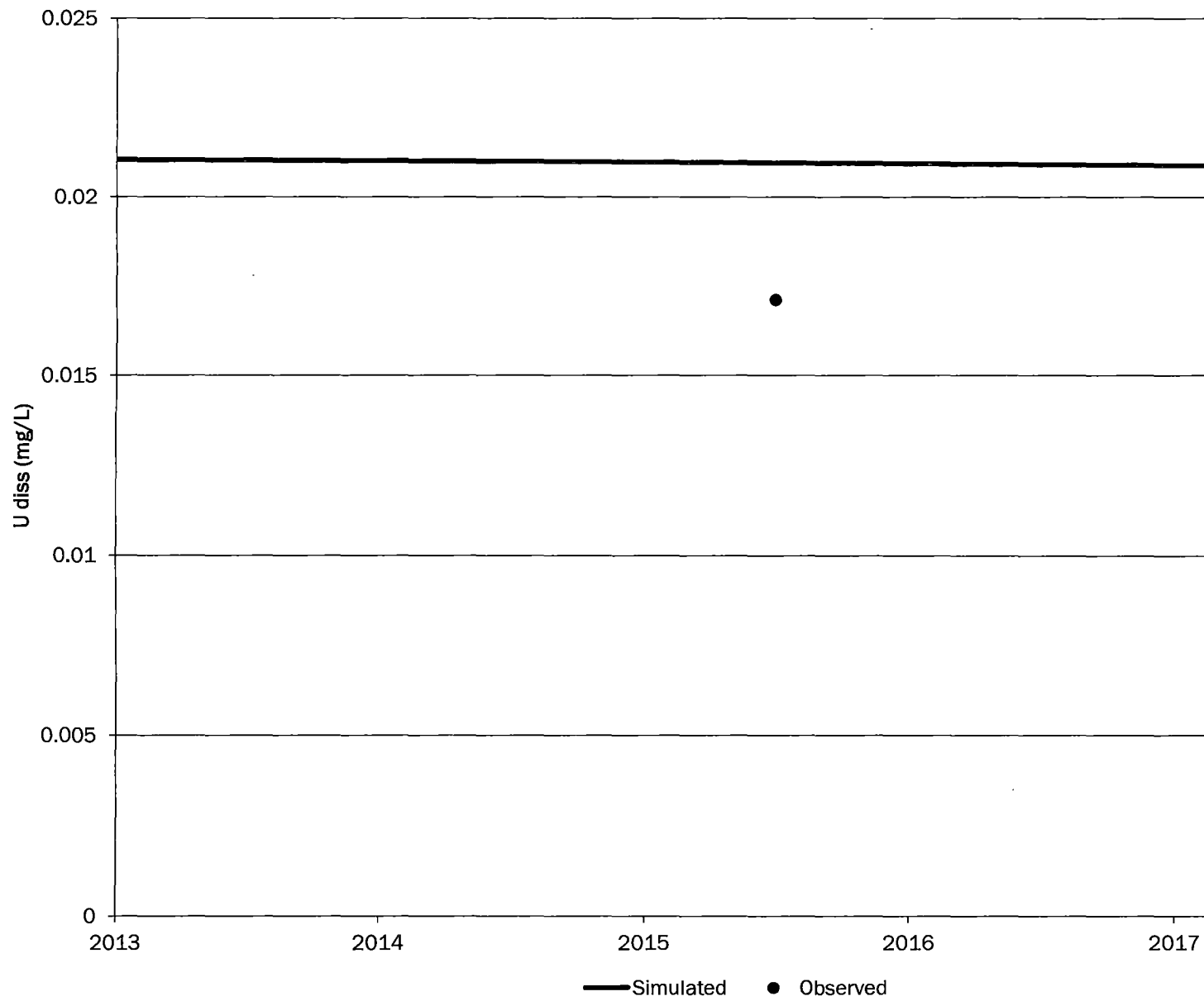
0845-AI



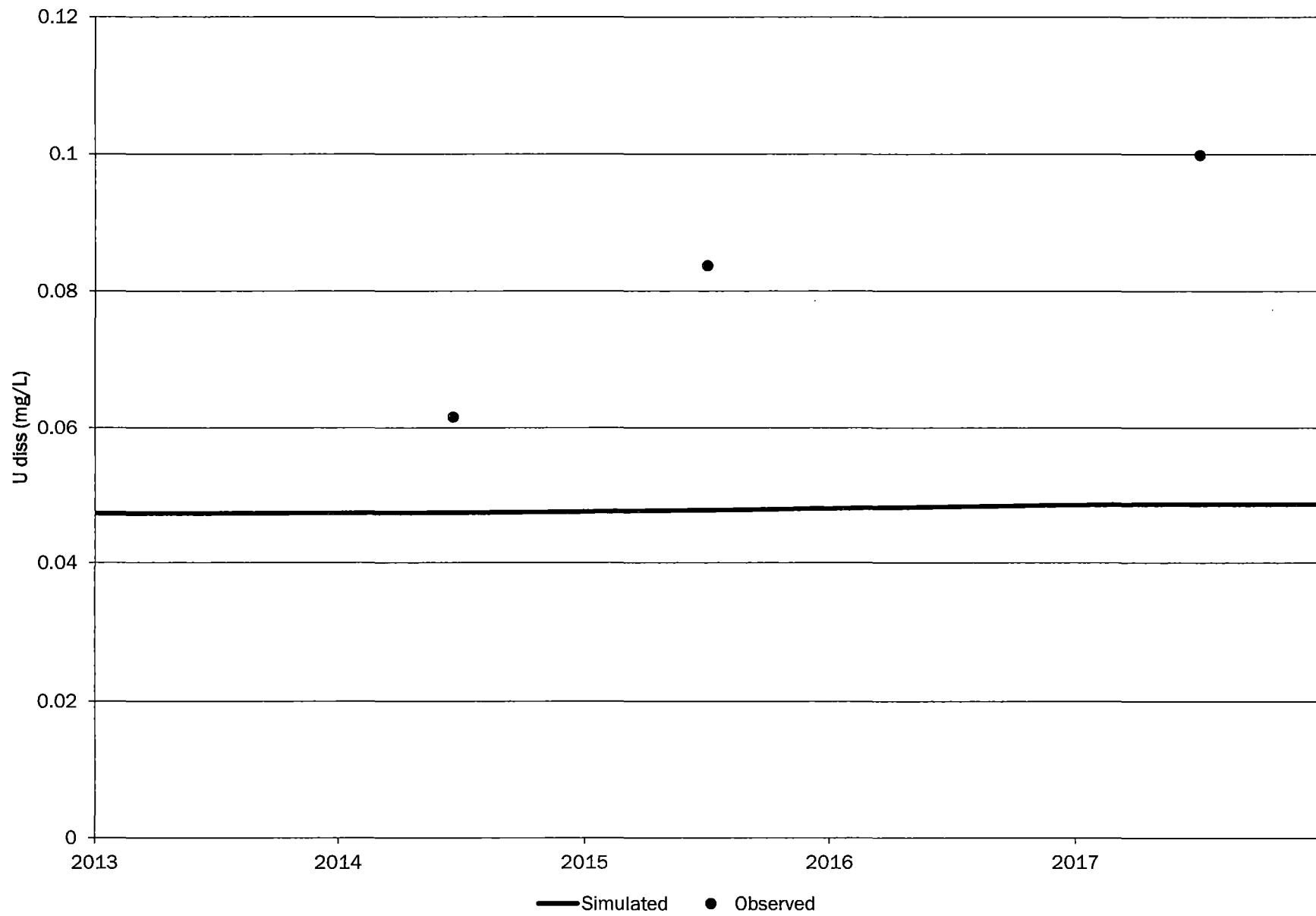
0846-AI



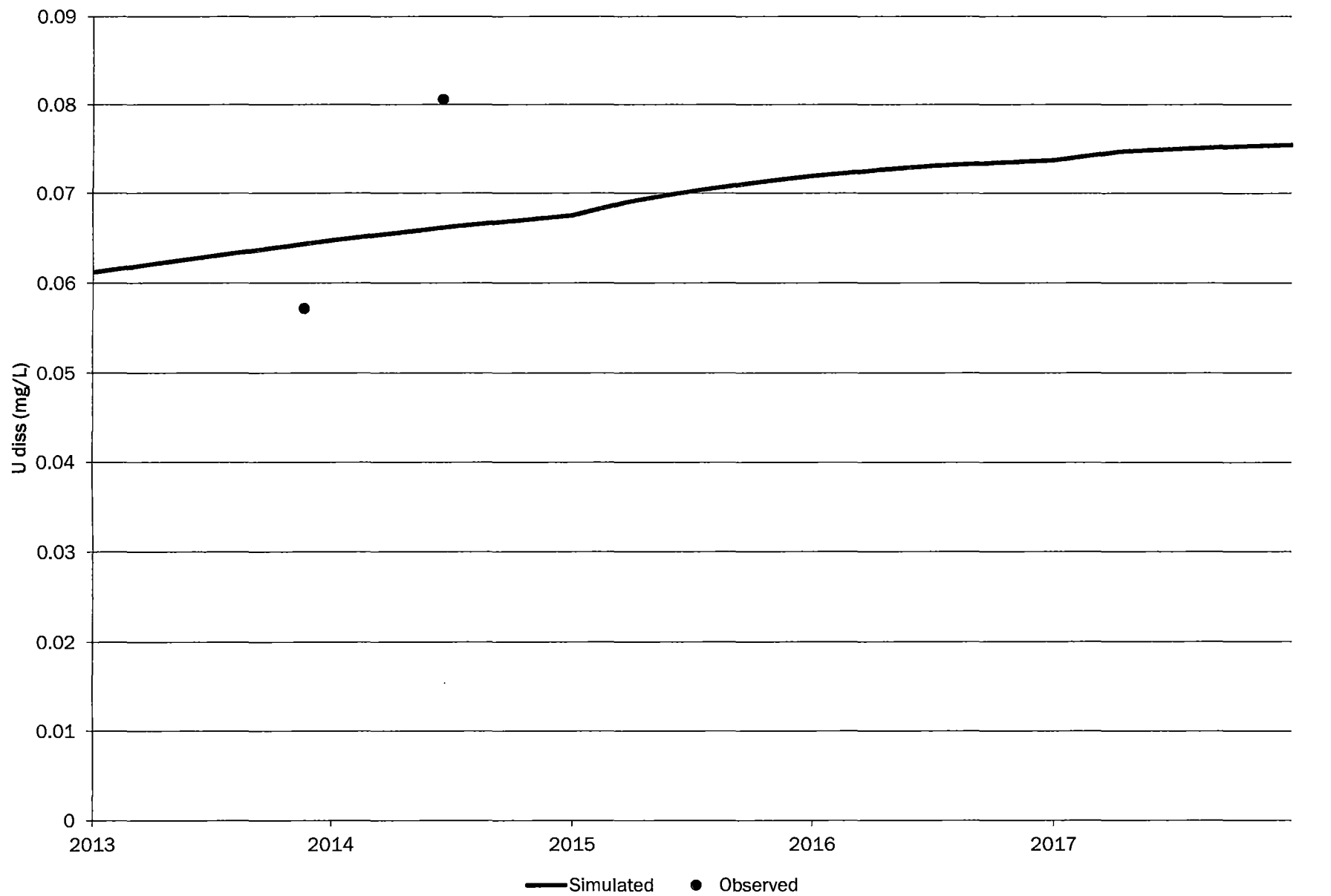
0852-AI



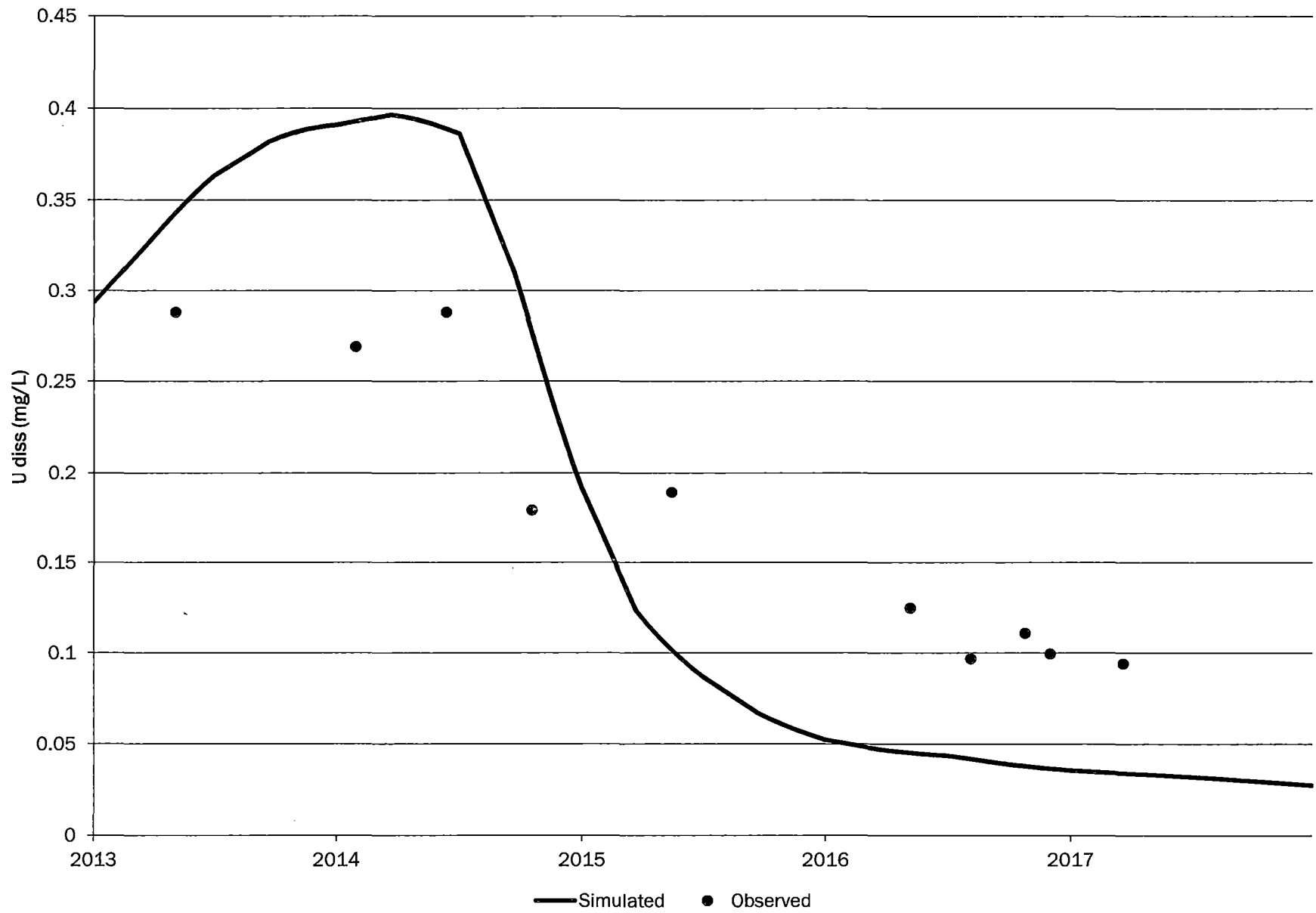
0853-LC



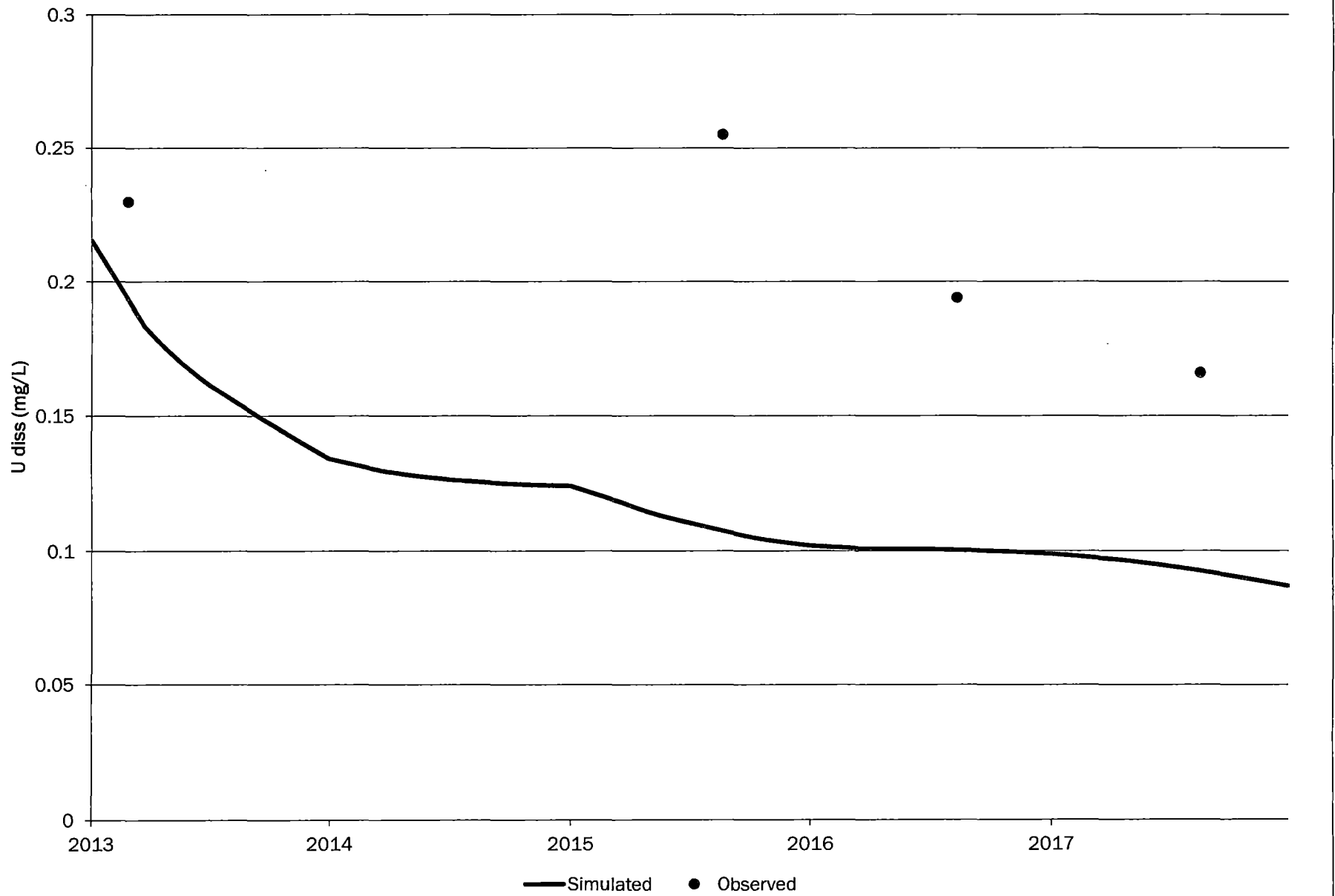
0859-MC



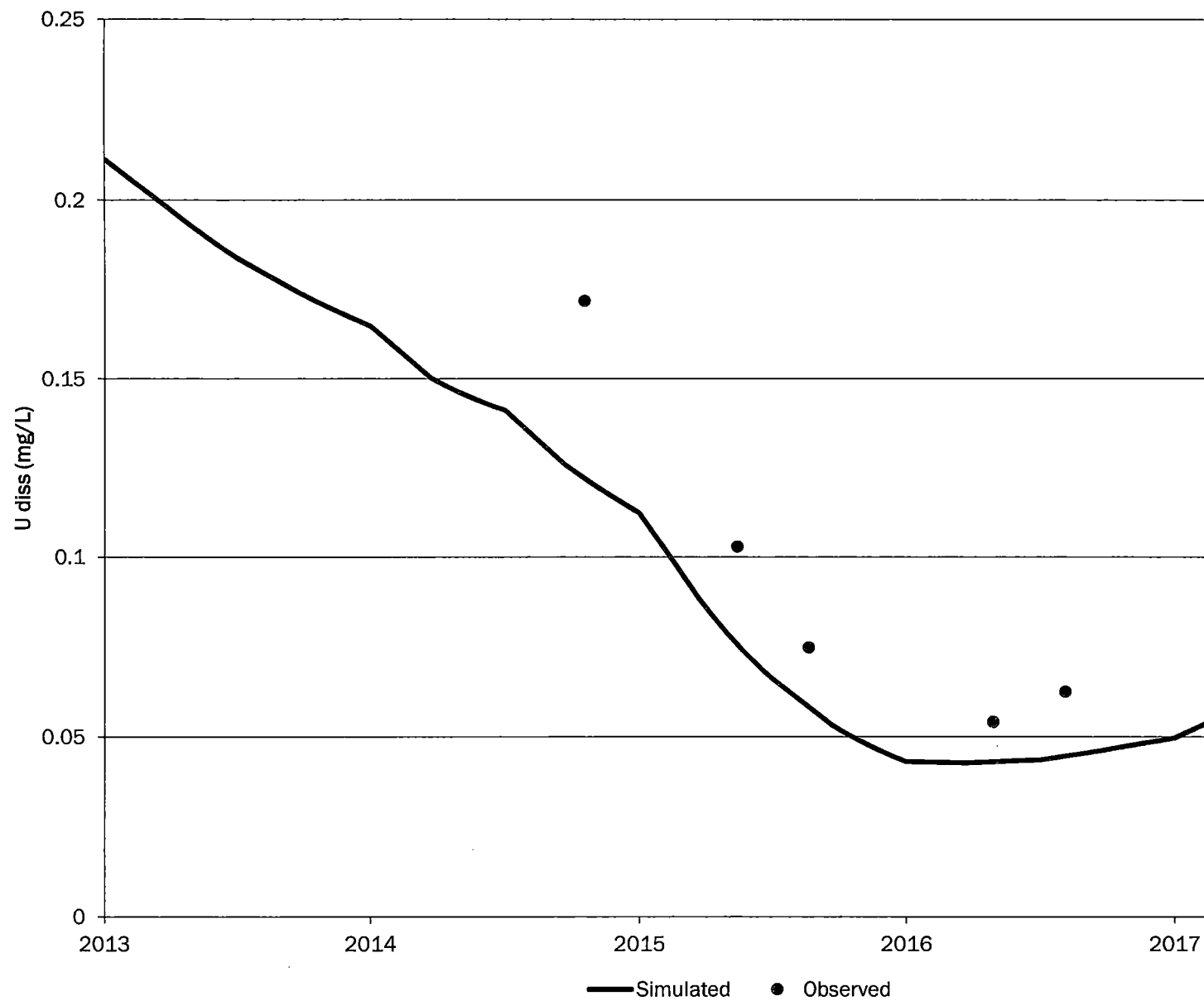
0862-AI



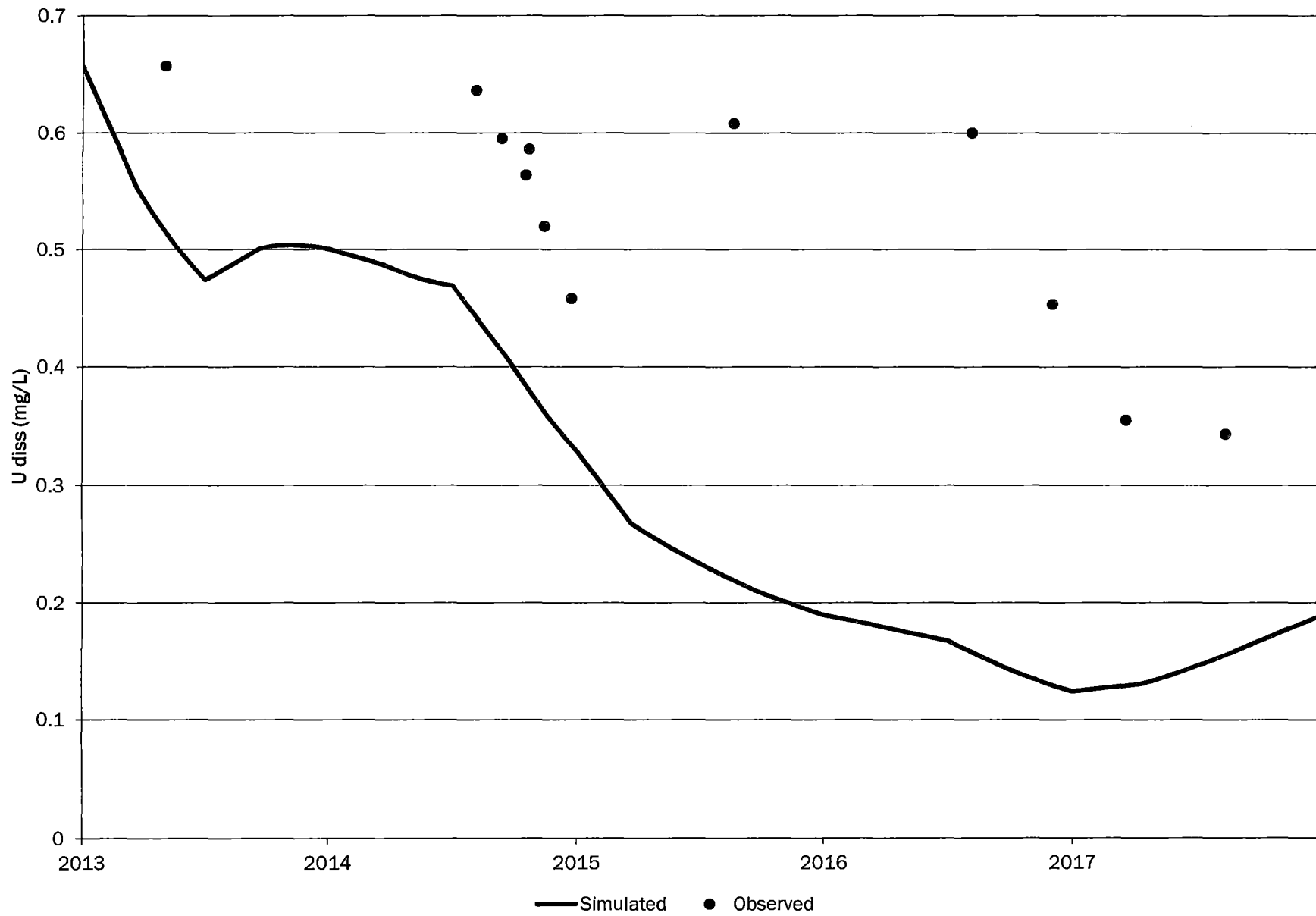
0864-AI



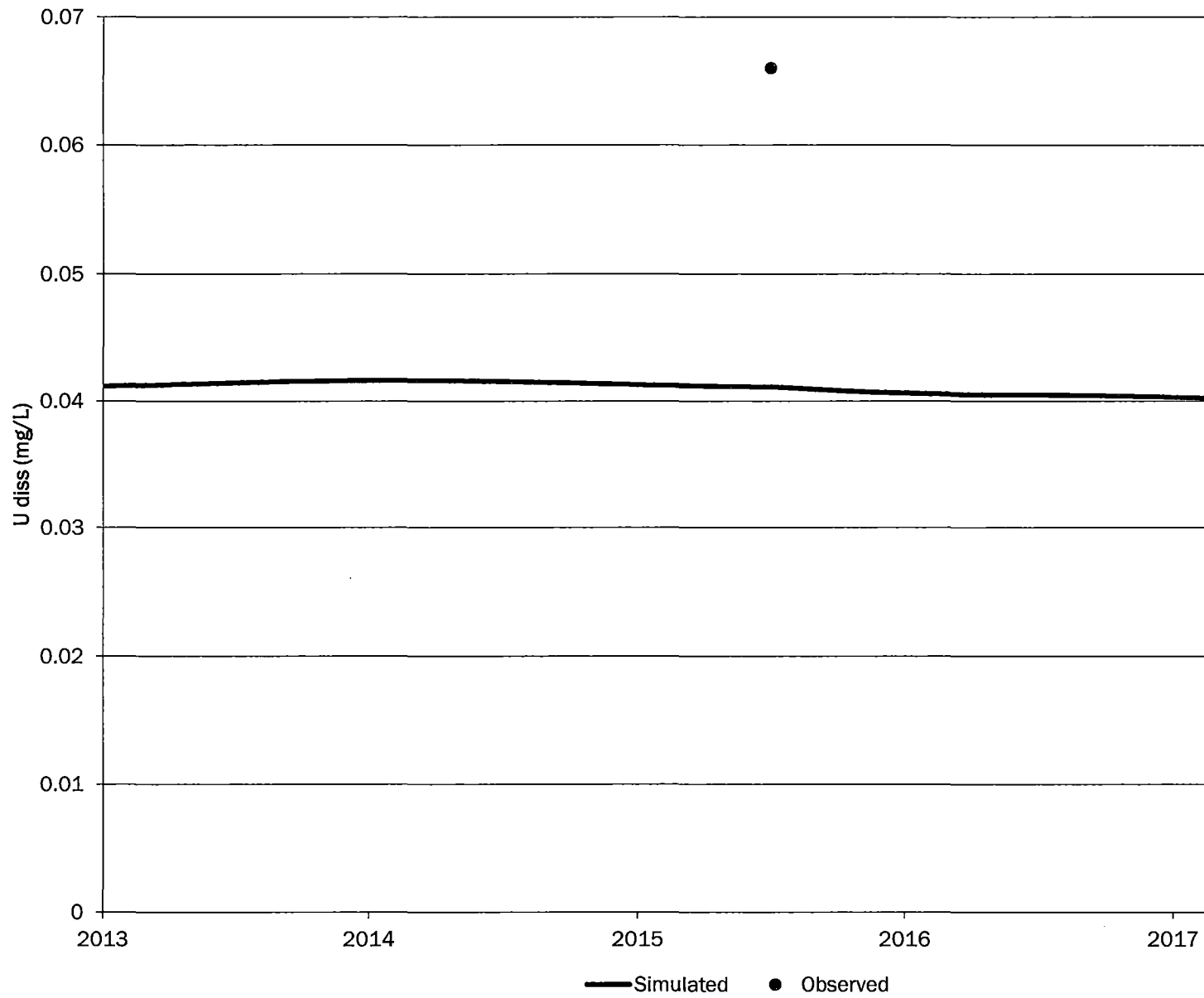
0865-AI



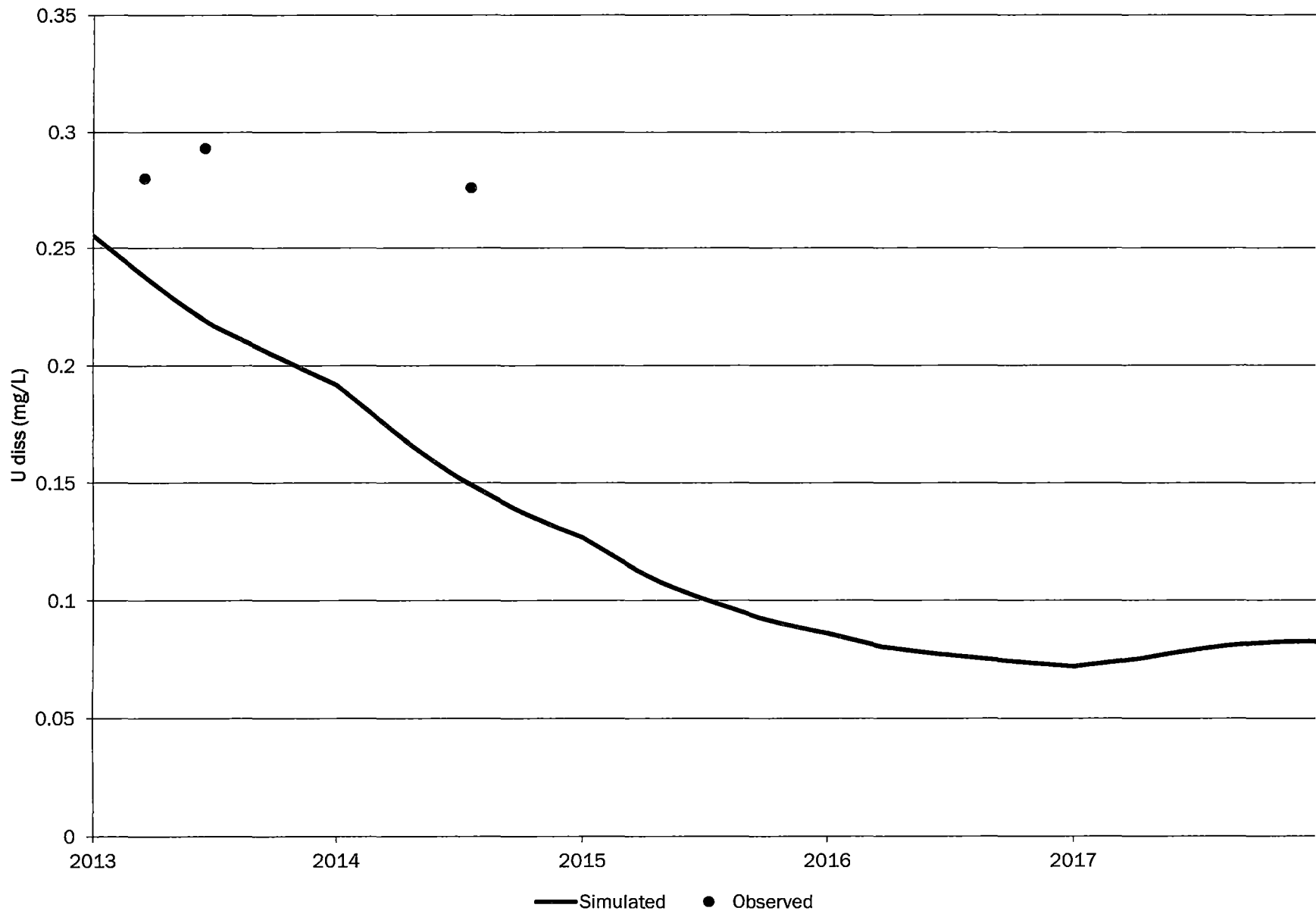
0866-AI



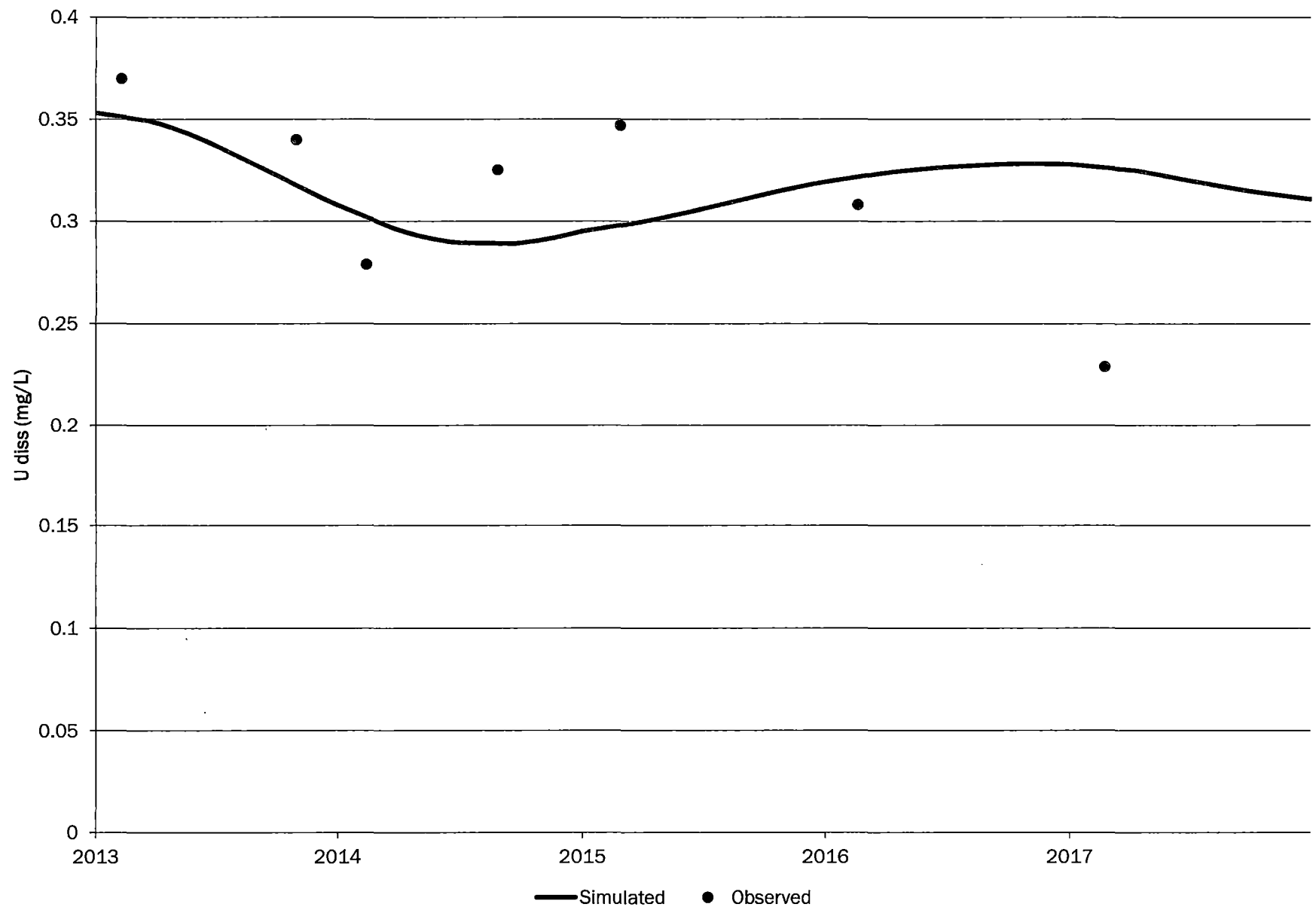
0868-AI



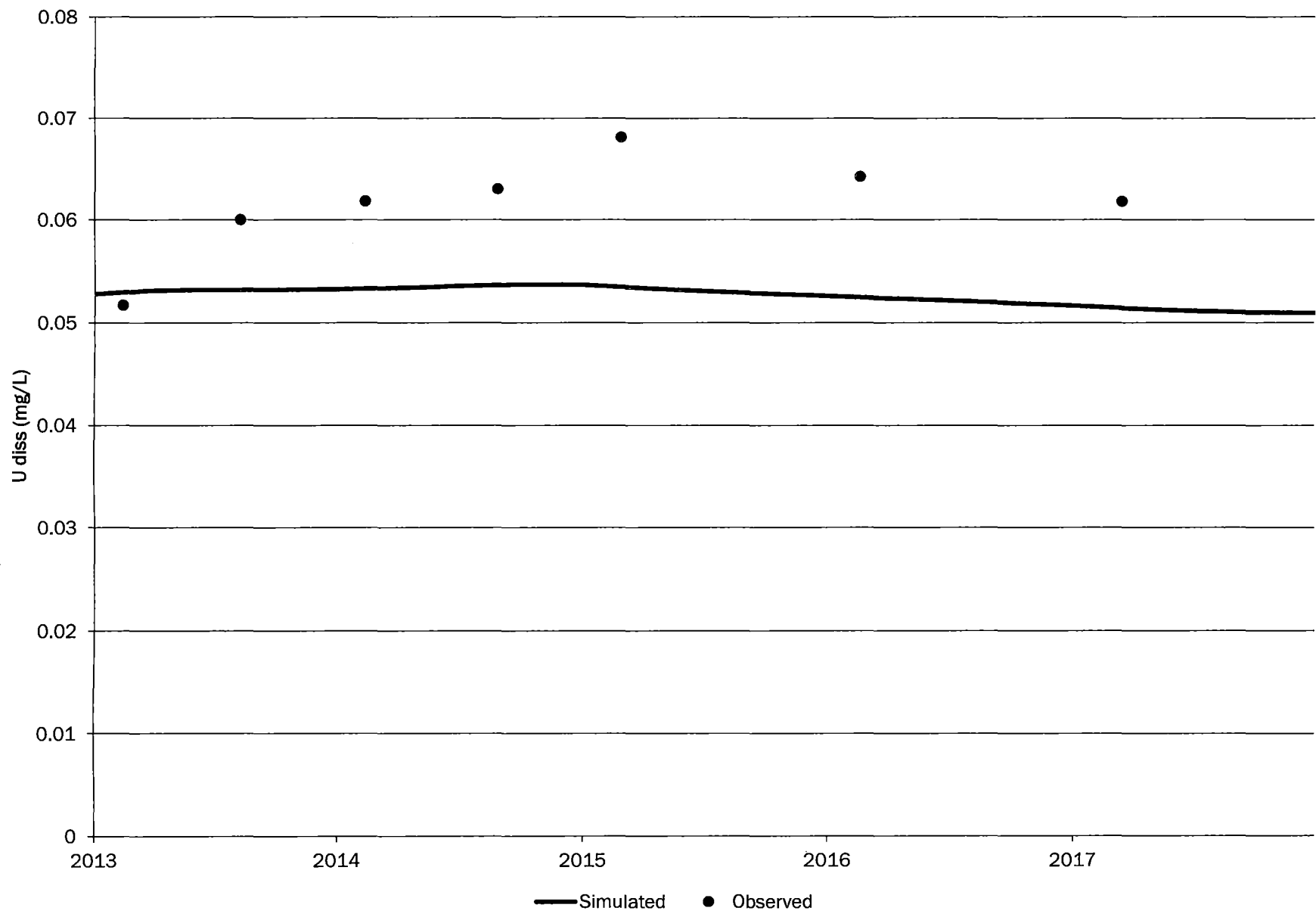
0869-AI



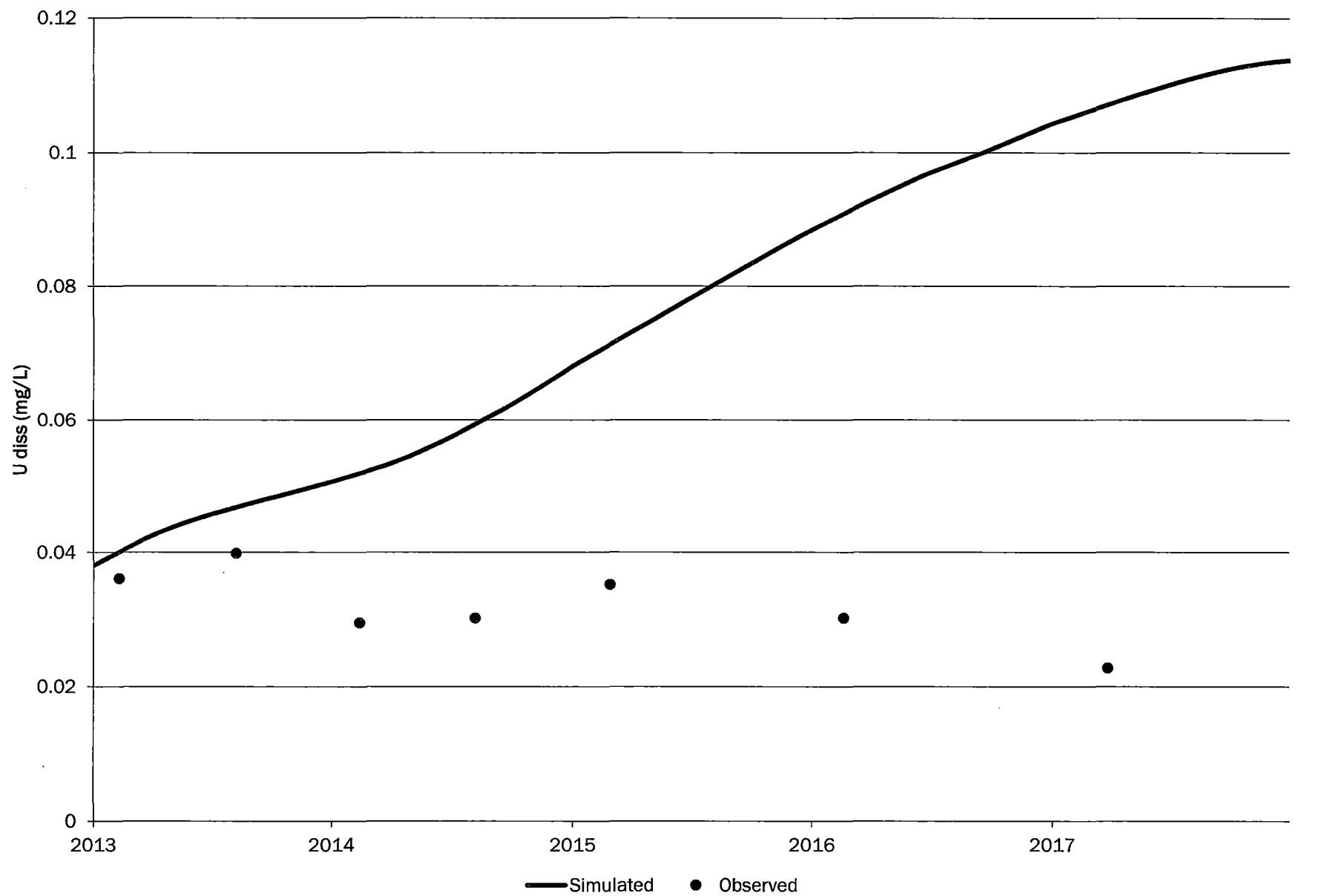
0881-AI



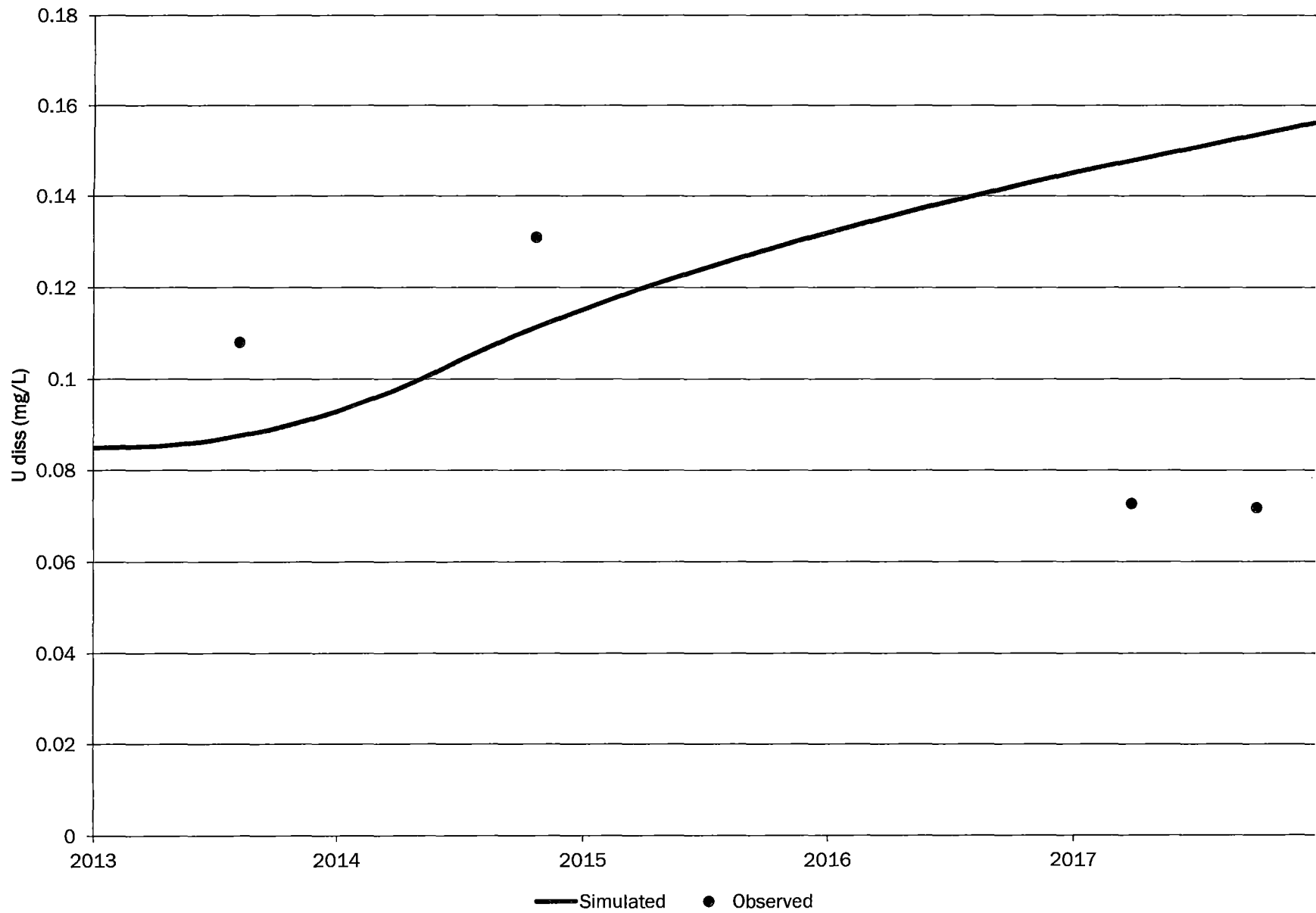
0882-AI



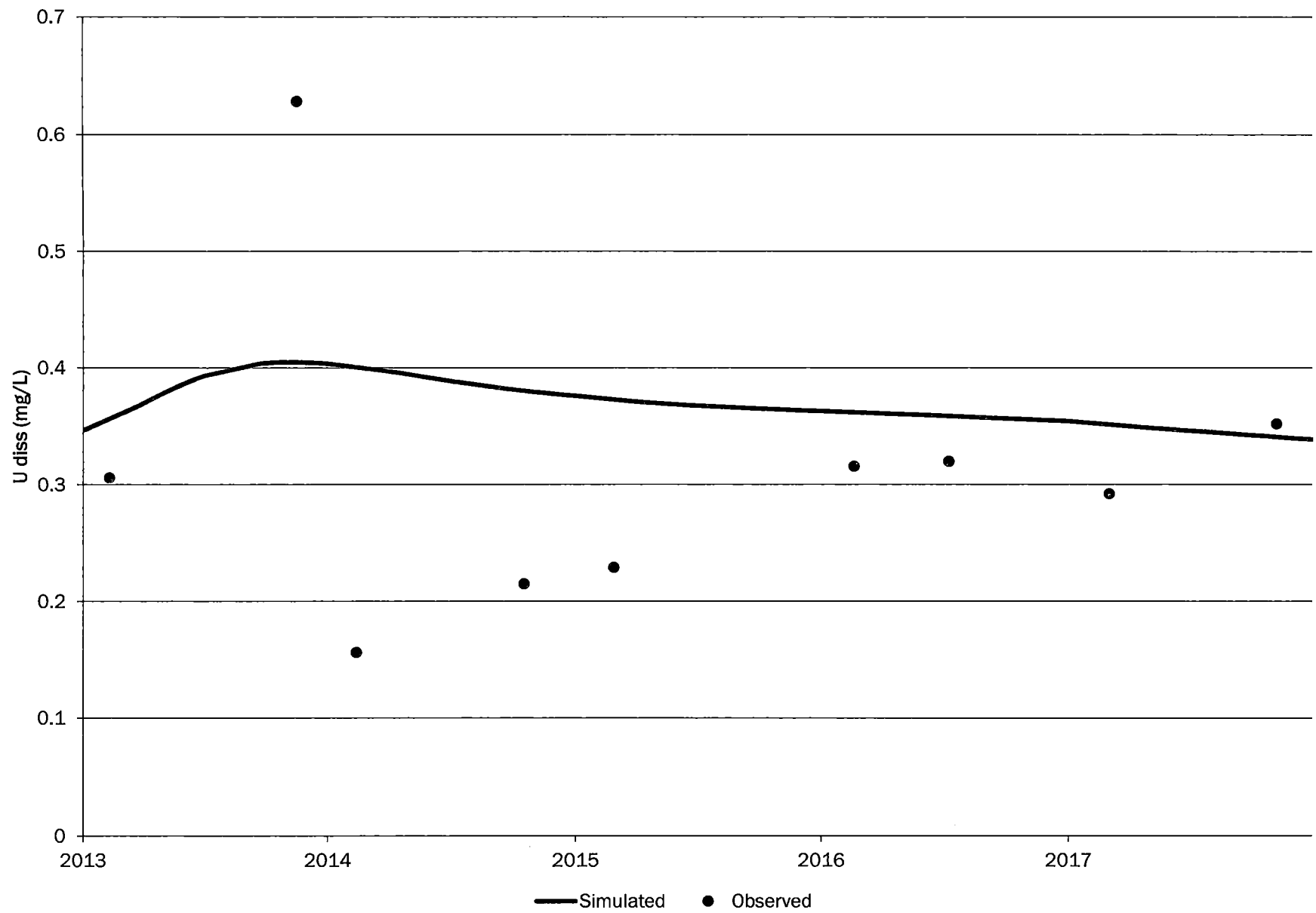
0884-AI



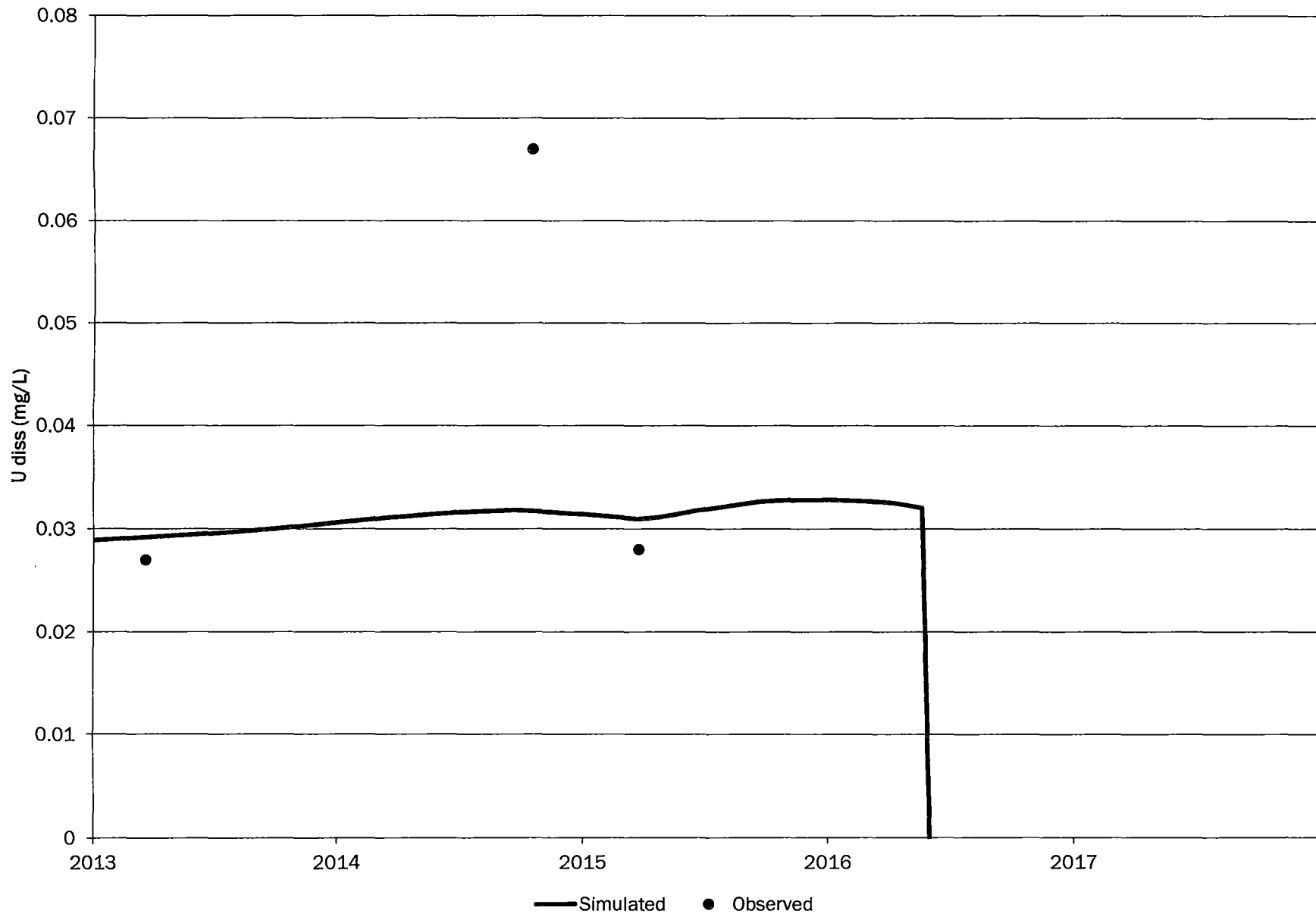
0885-AI



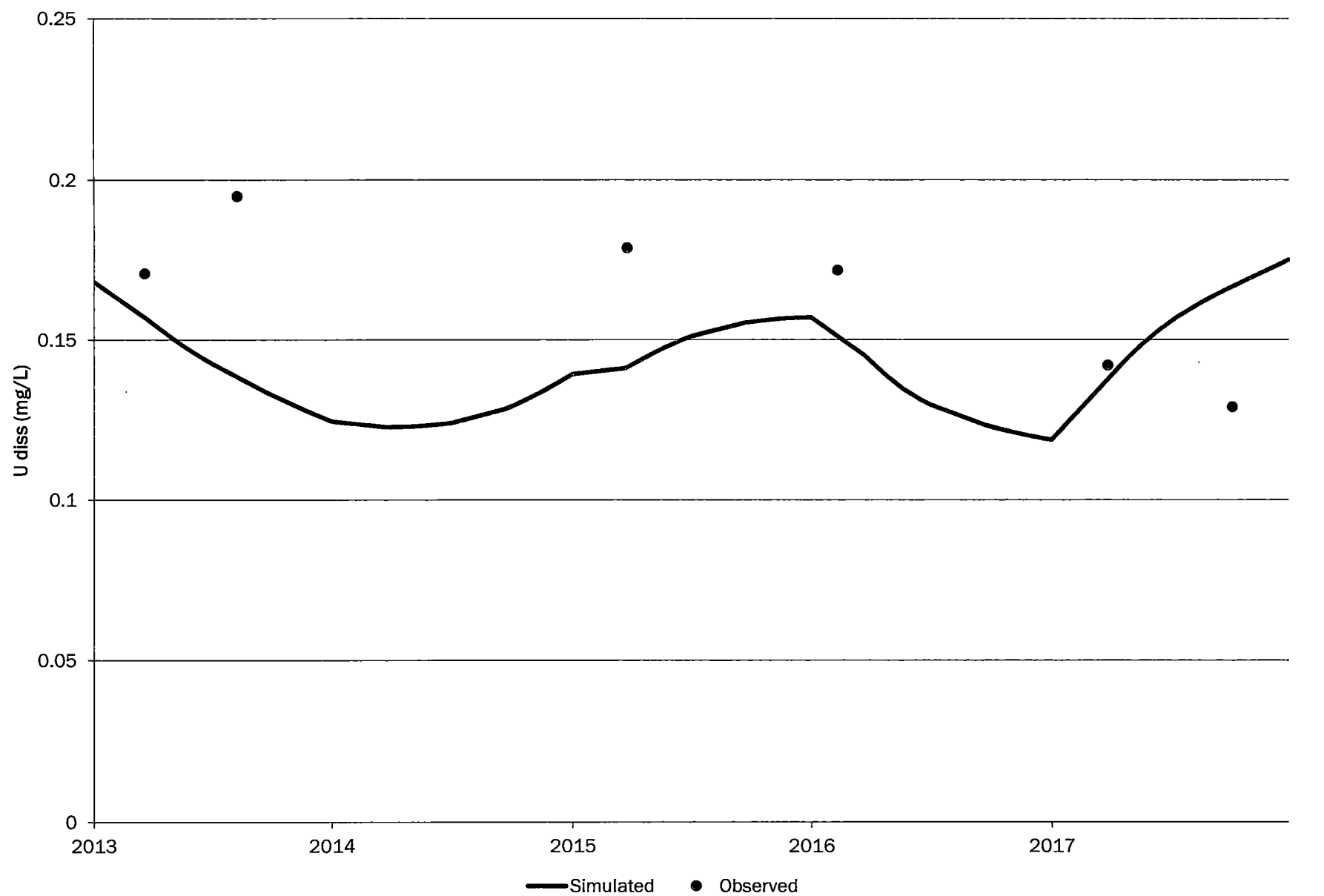
0886-AI



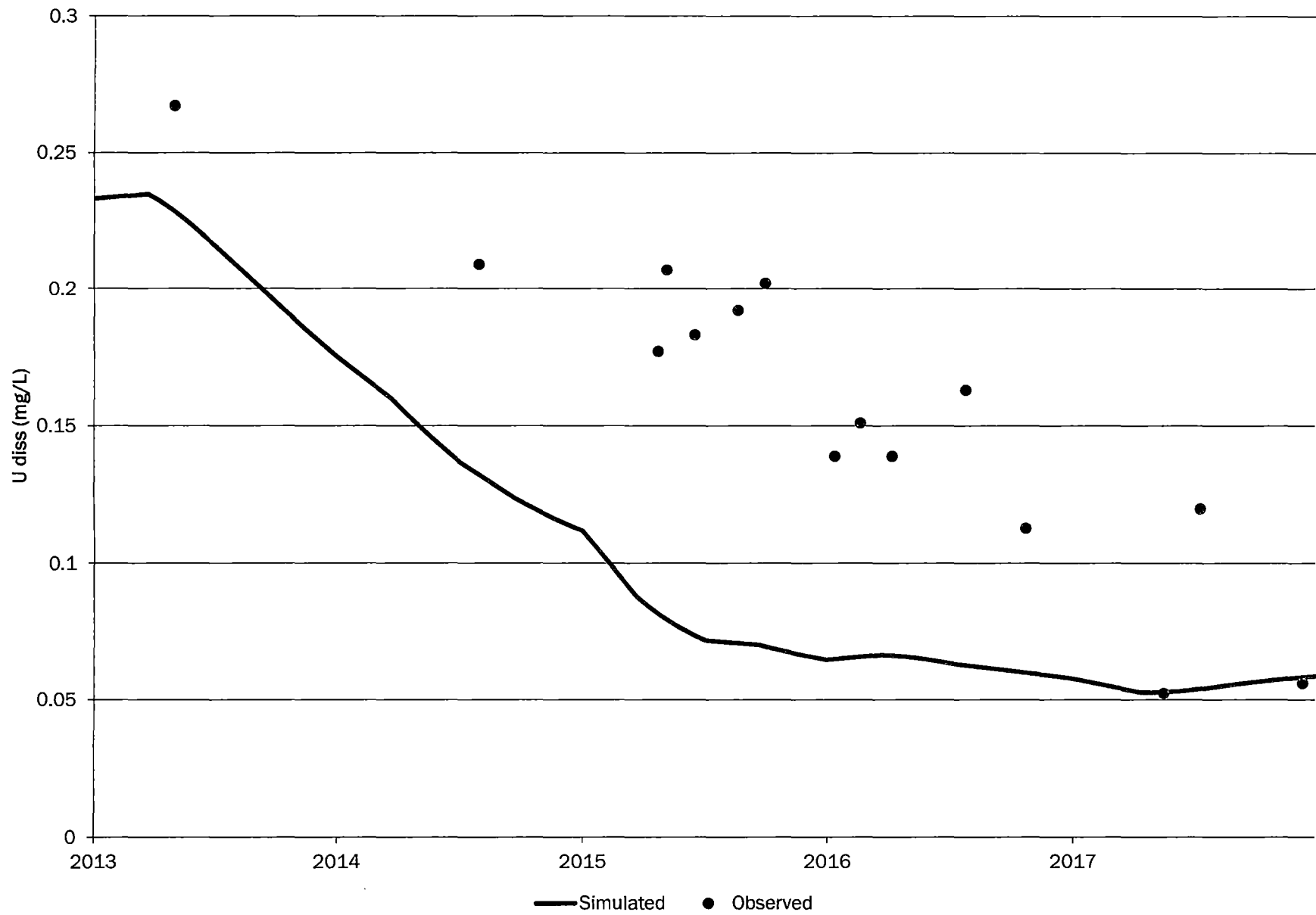
0887-AI



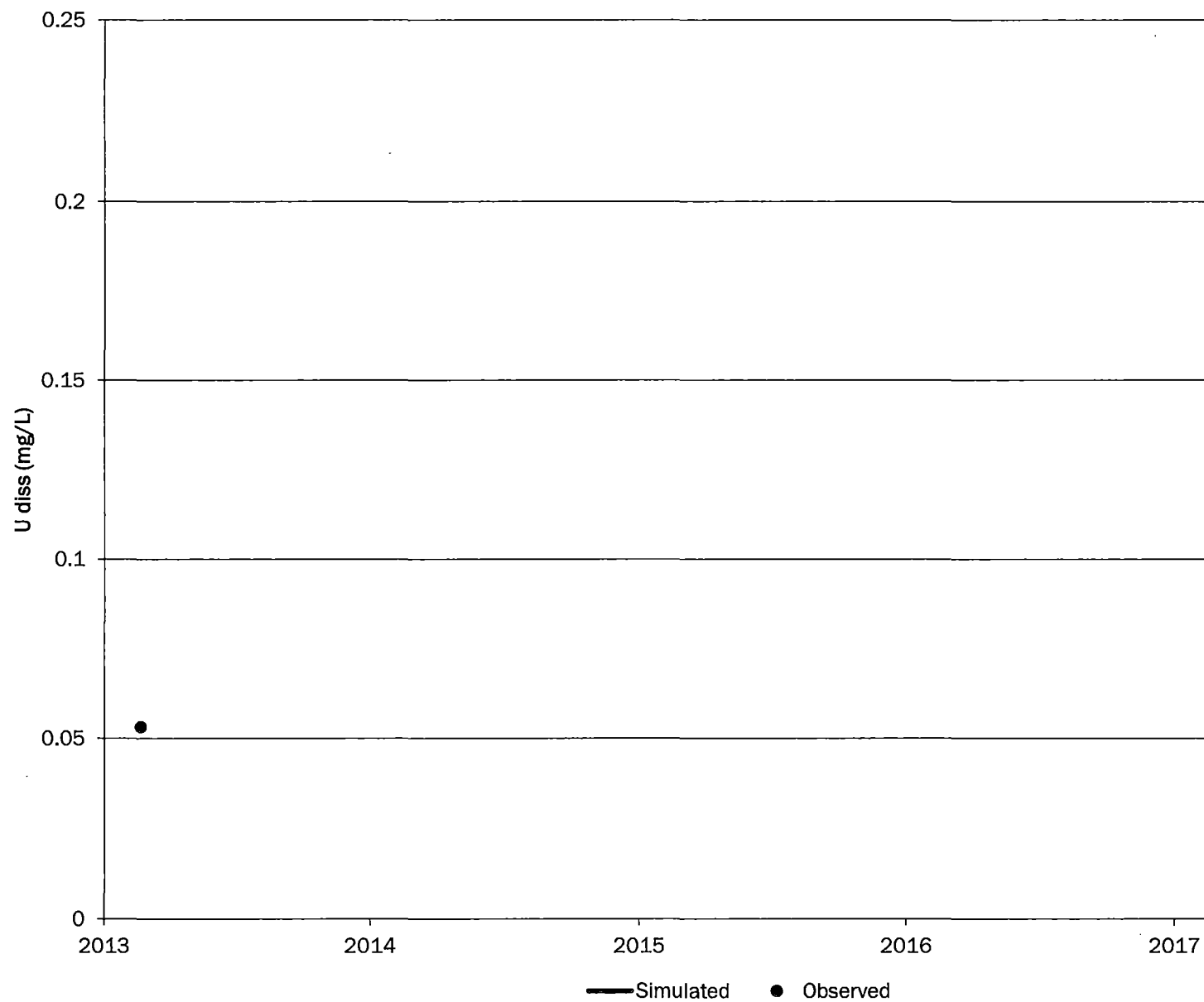
0888-AI



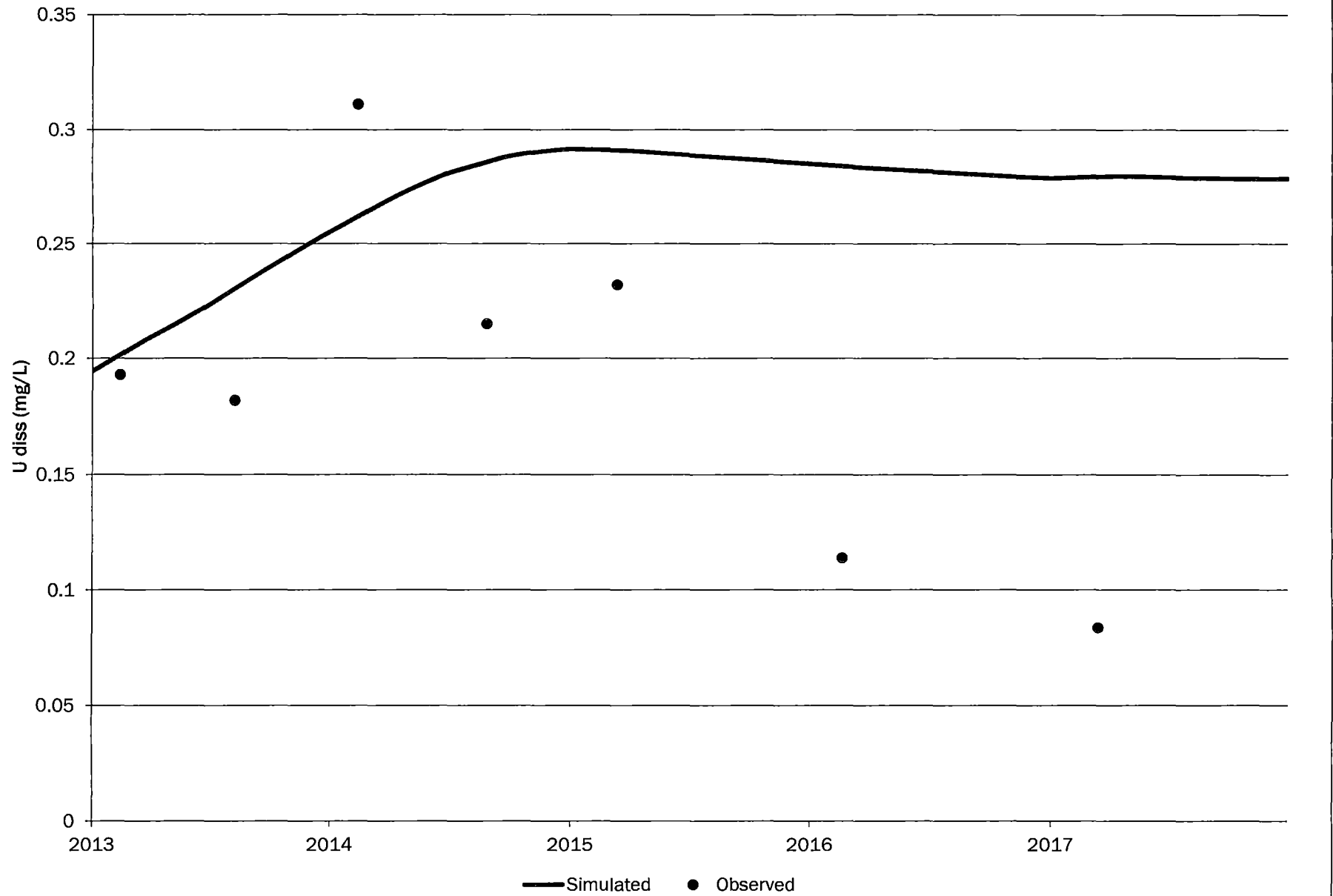
0890-AI



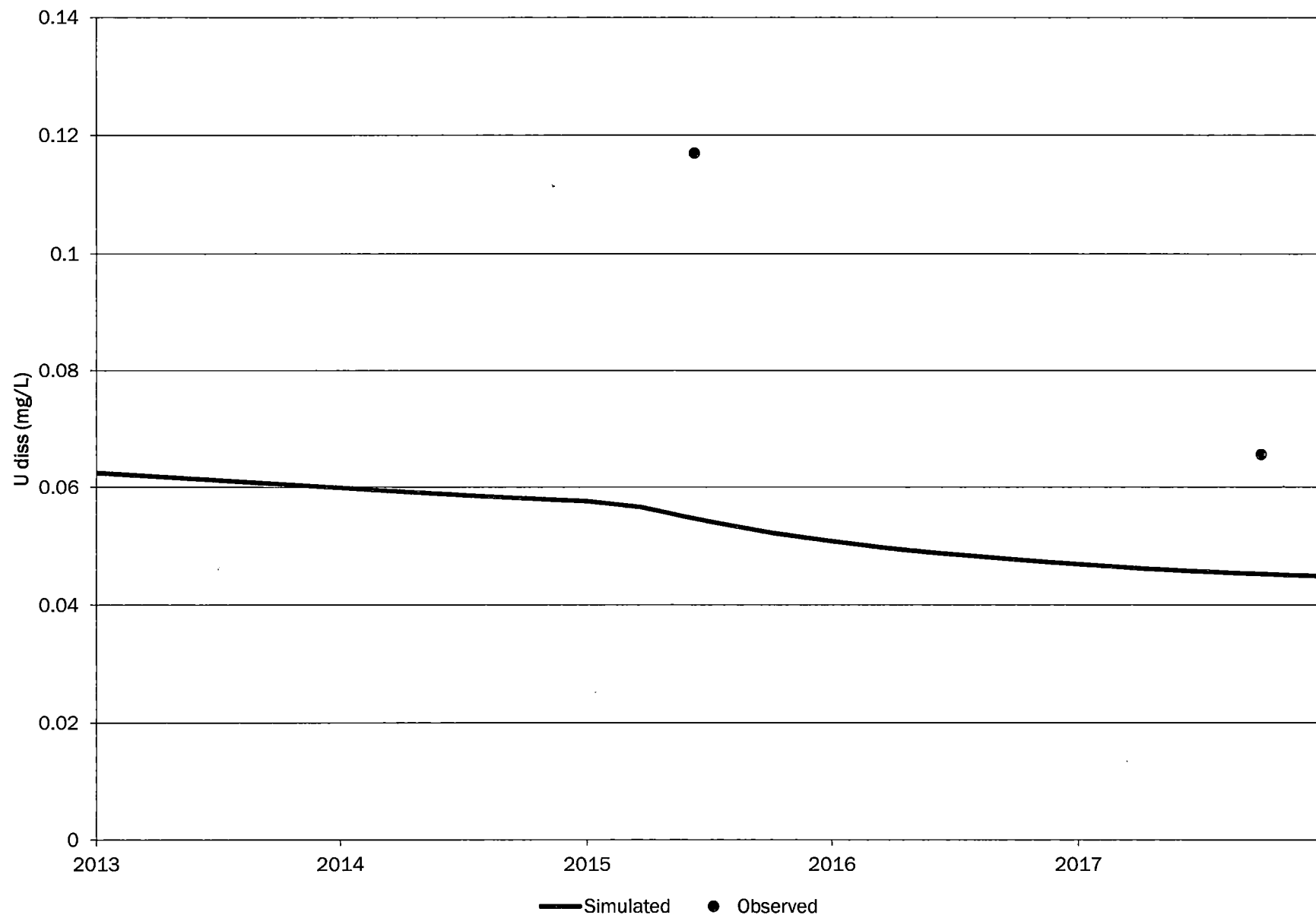
0891-AI



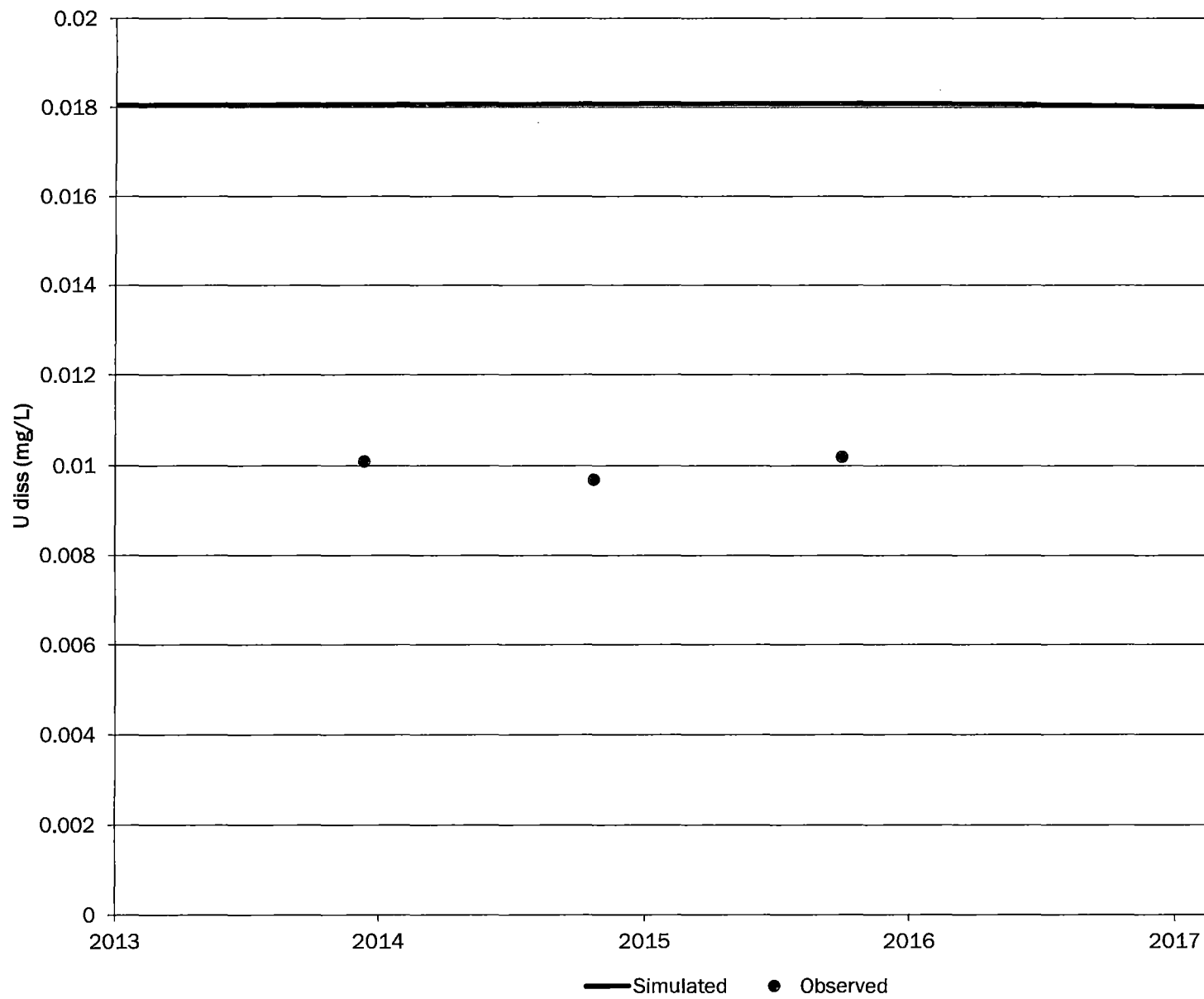
0893-AI



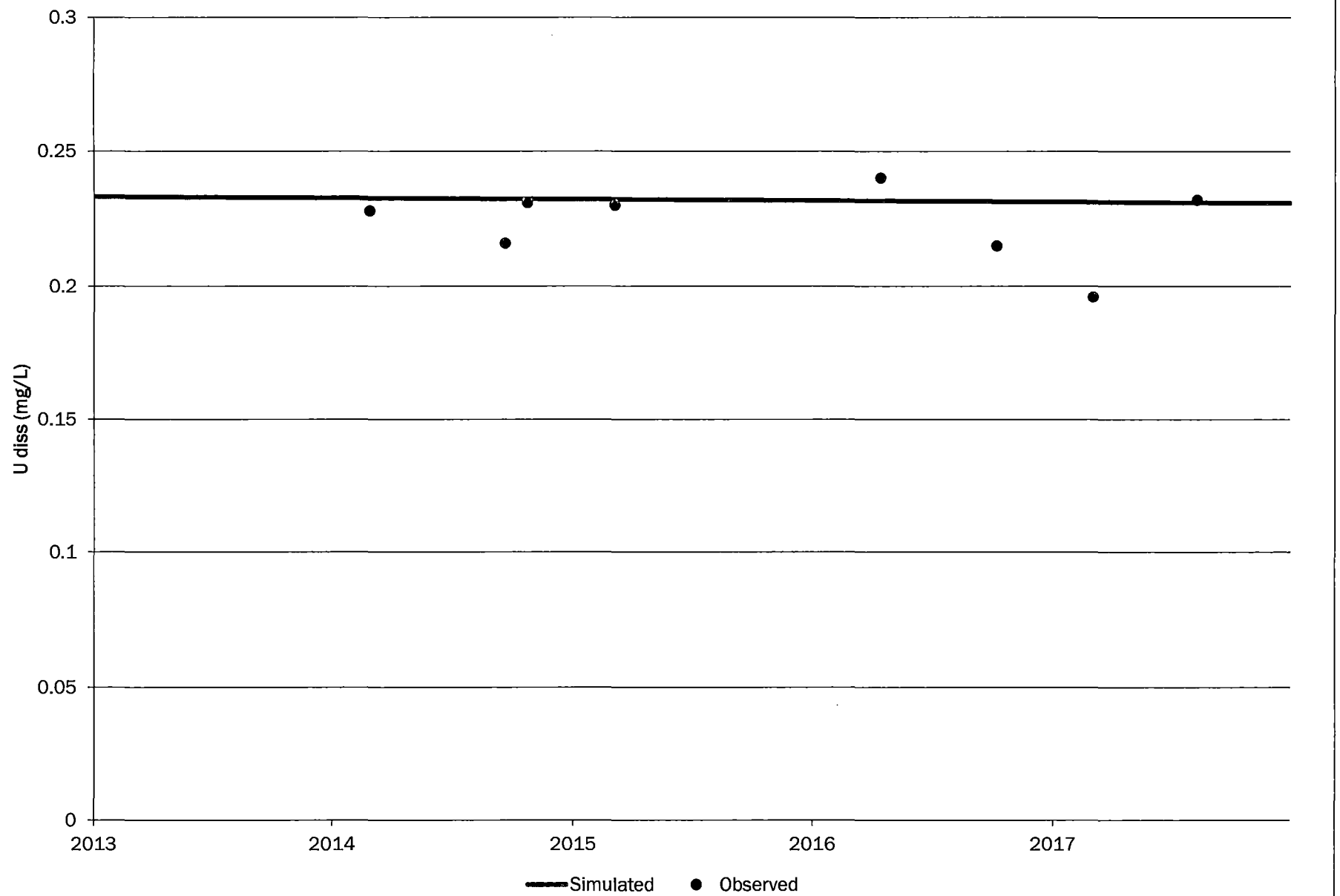
0899-AI



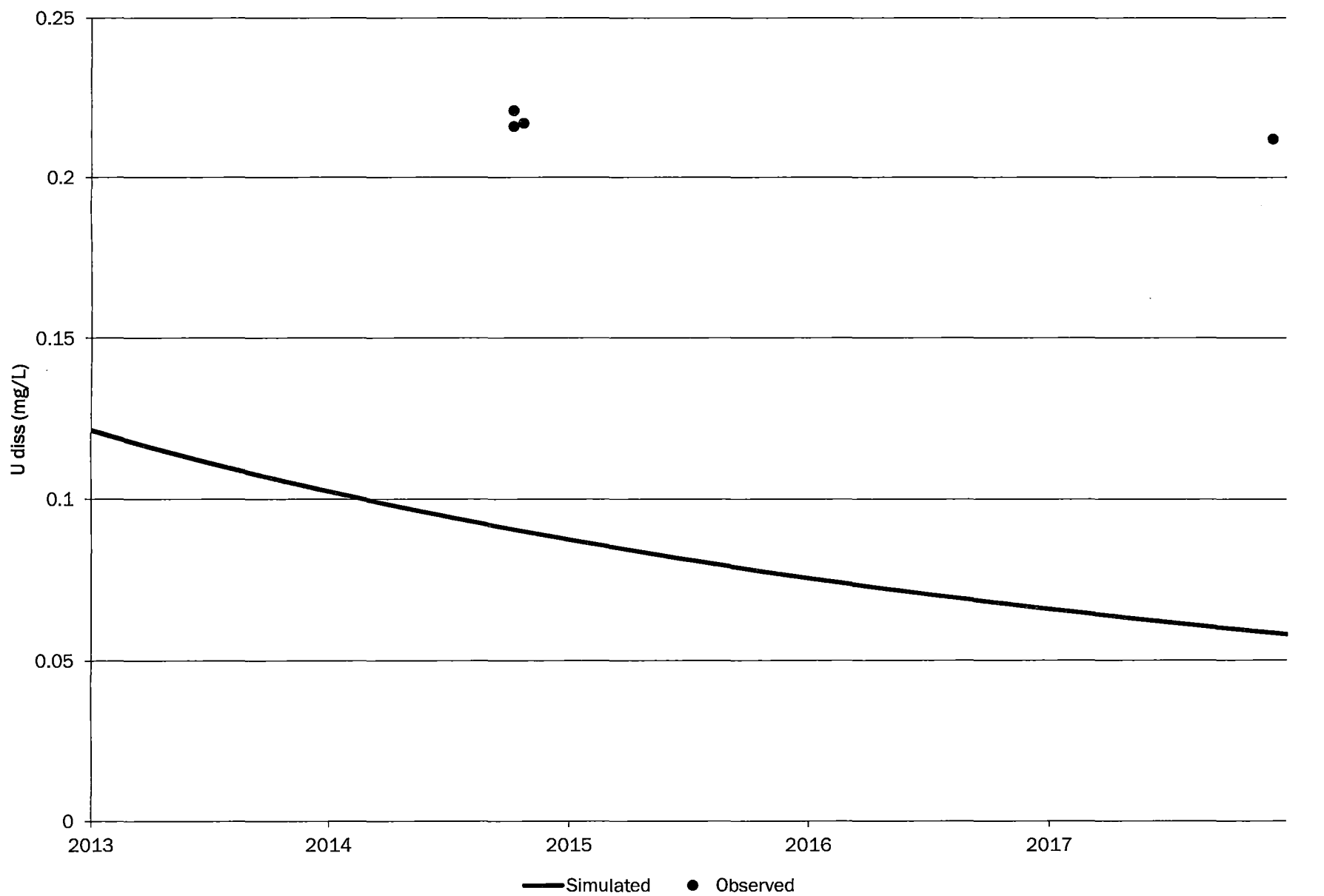
0910-AI



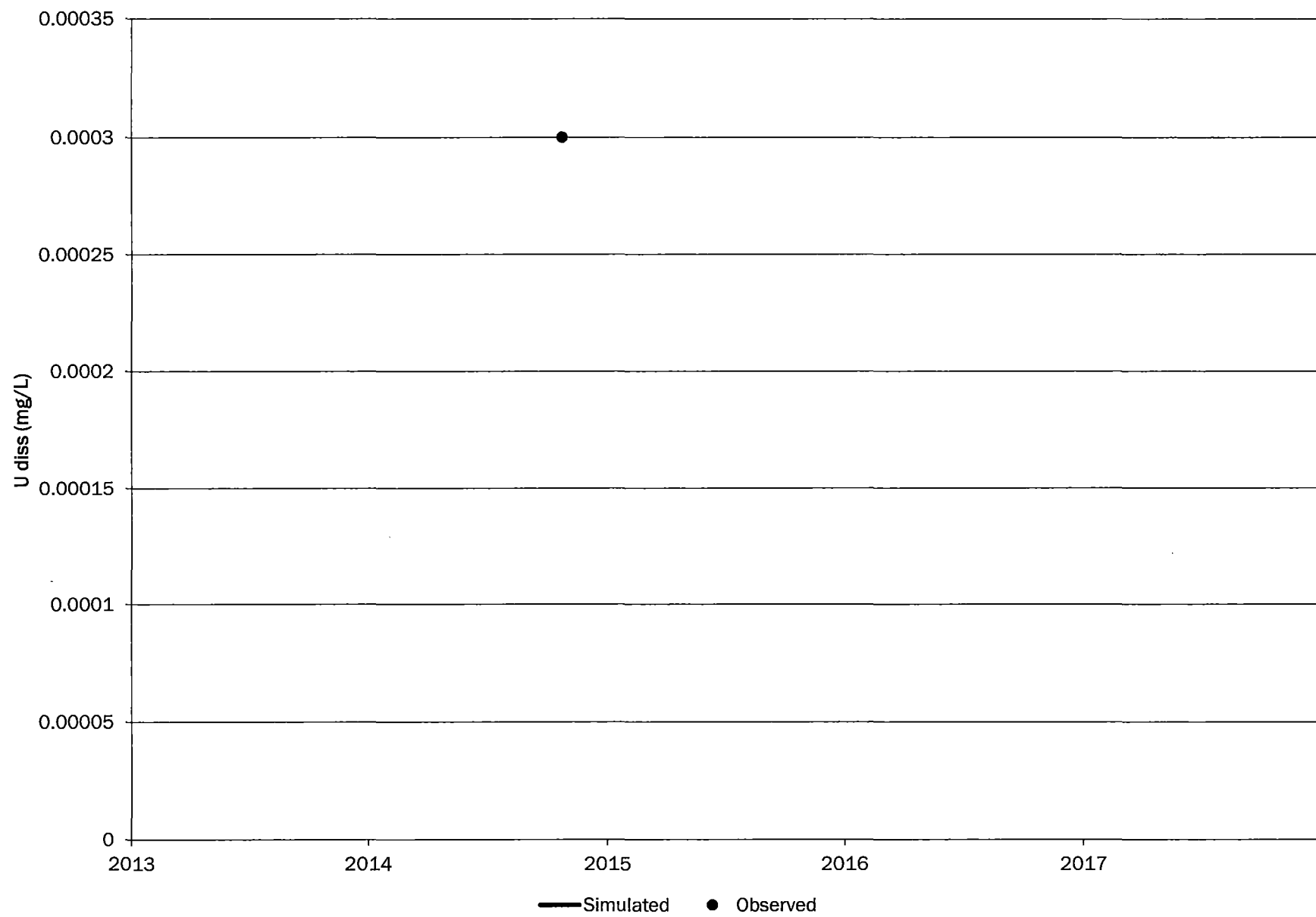
0920-AI



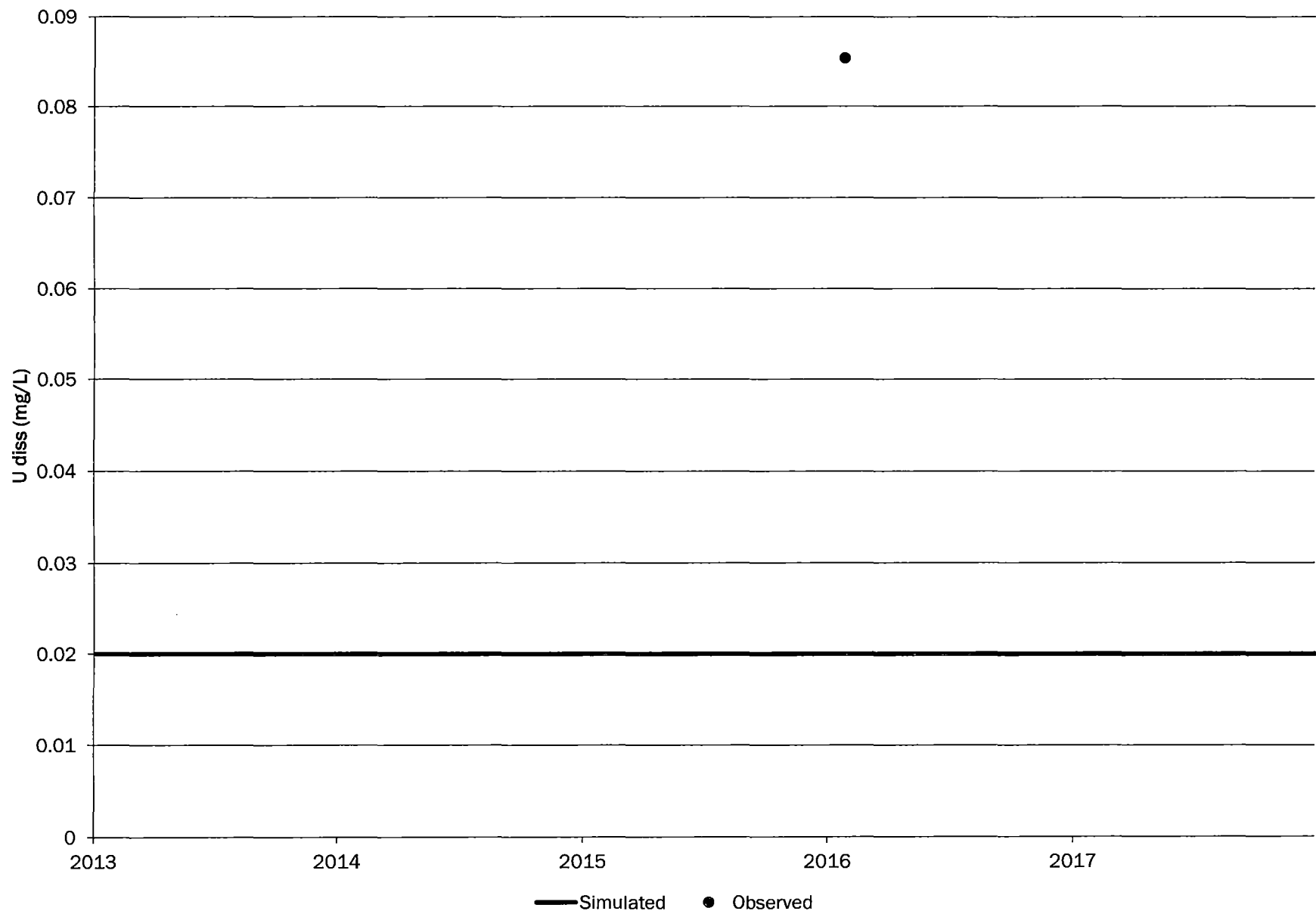
0921-AI



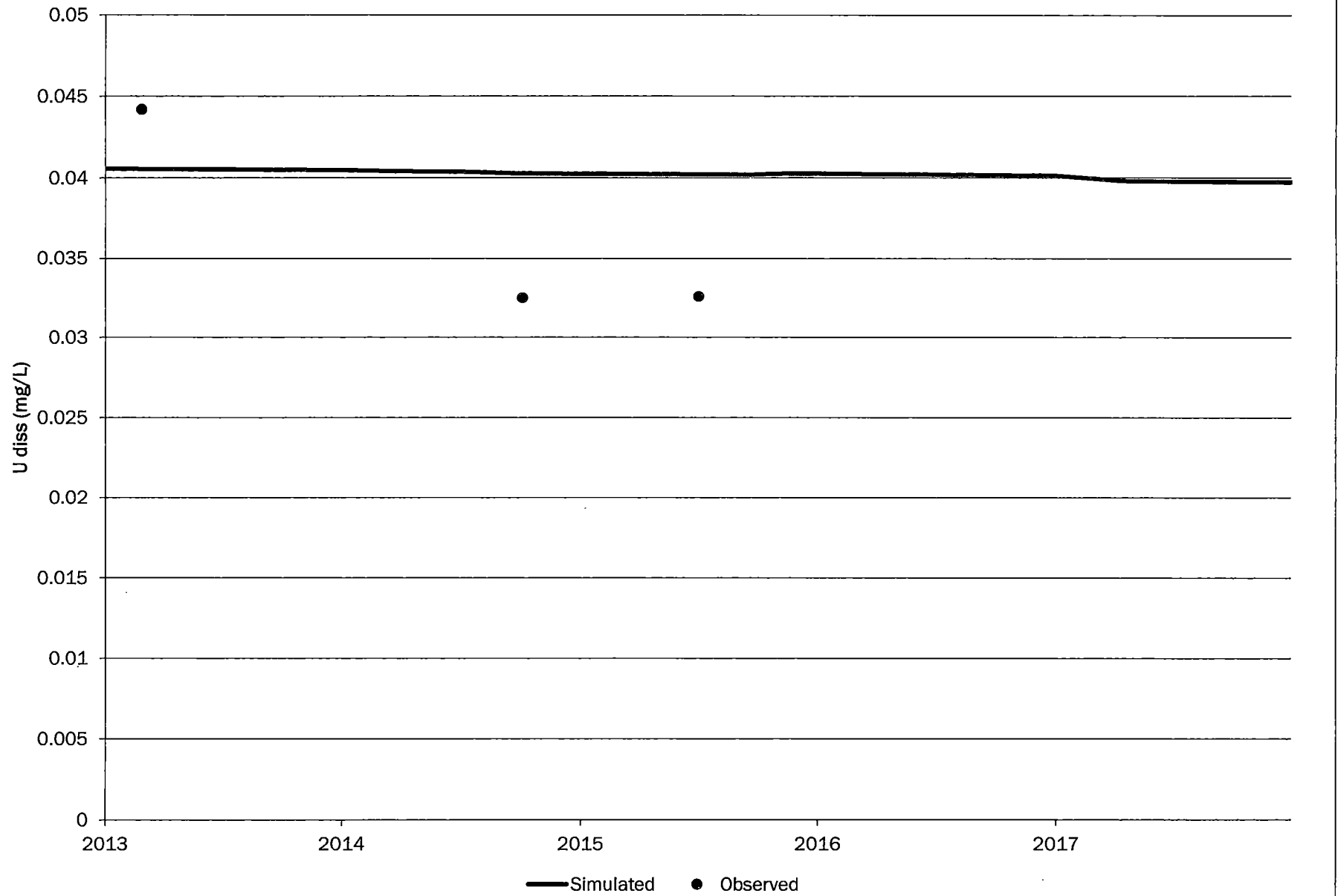
0922-AI



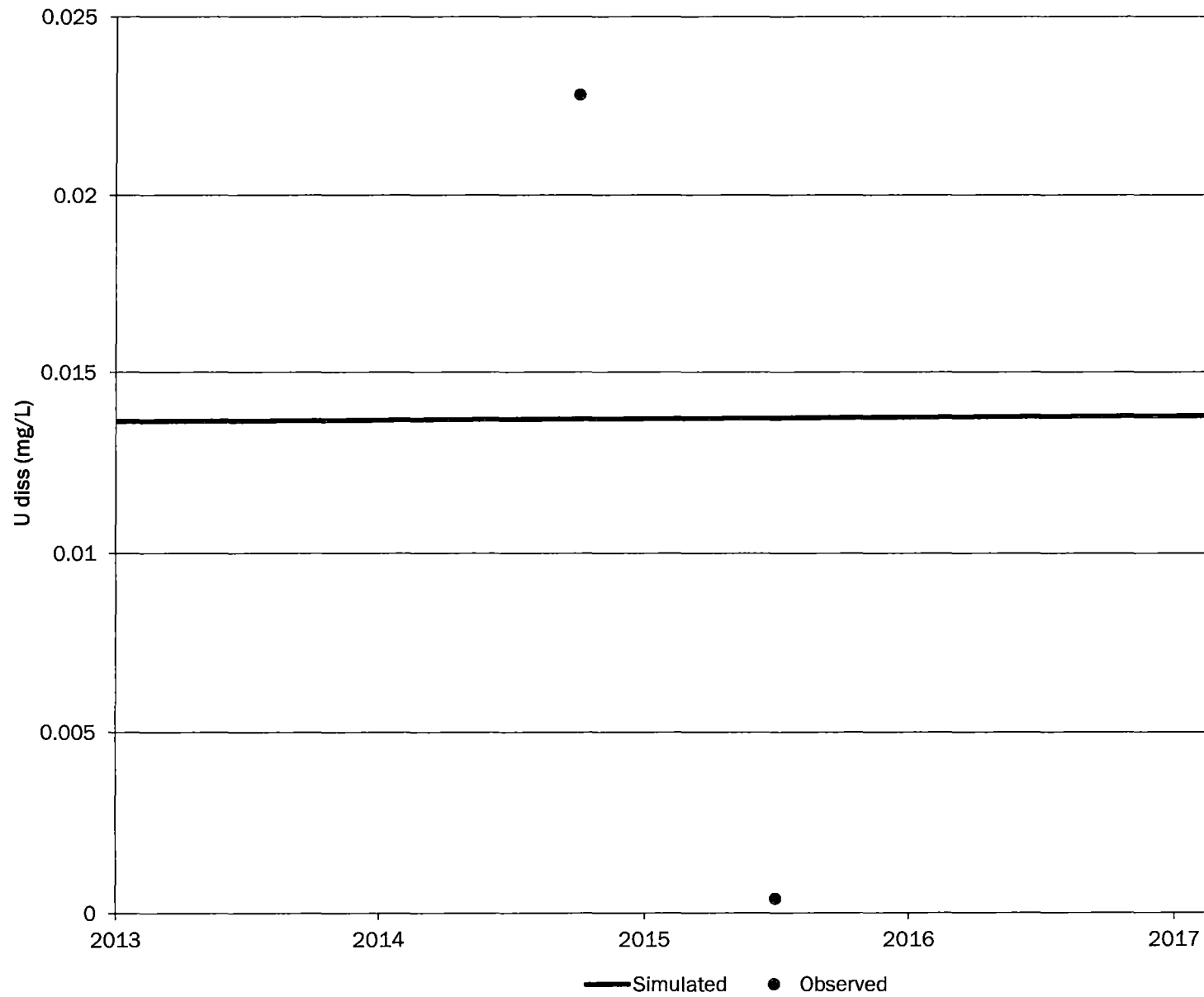
0928-SA



0929-UC



0930-MC



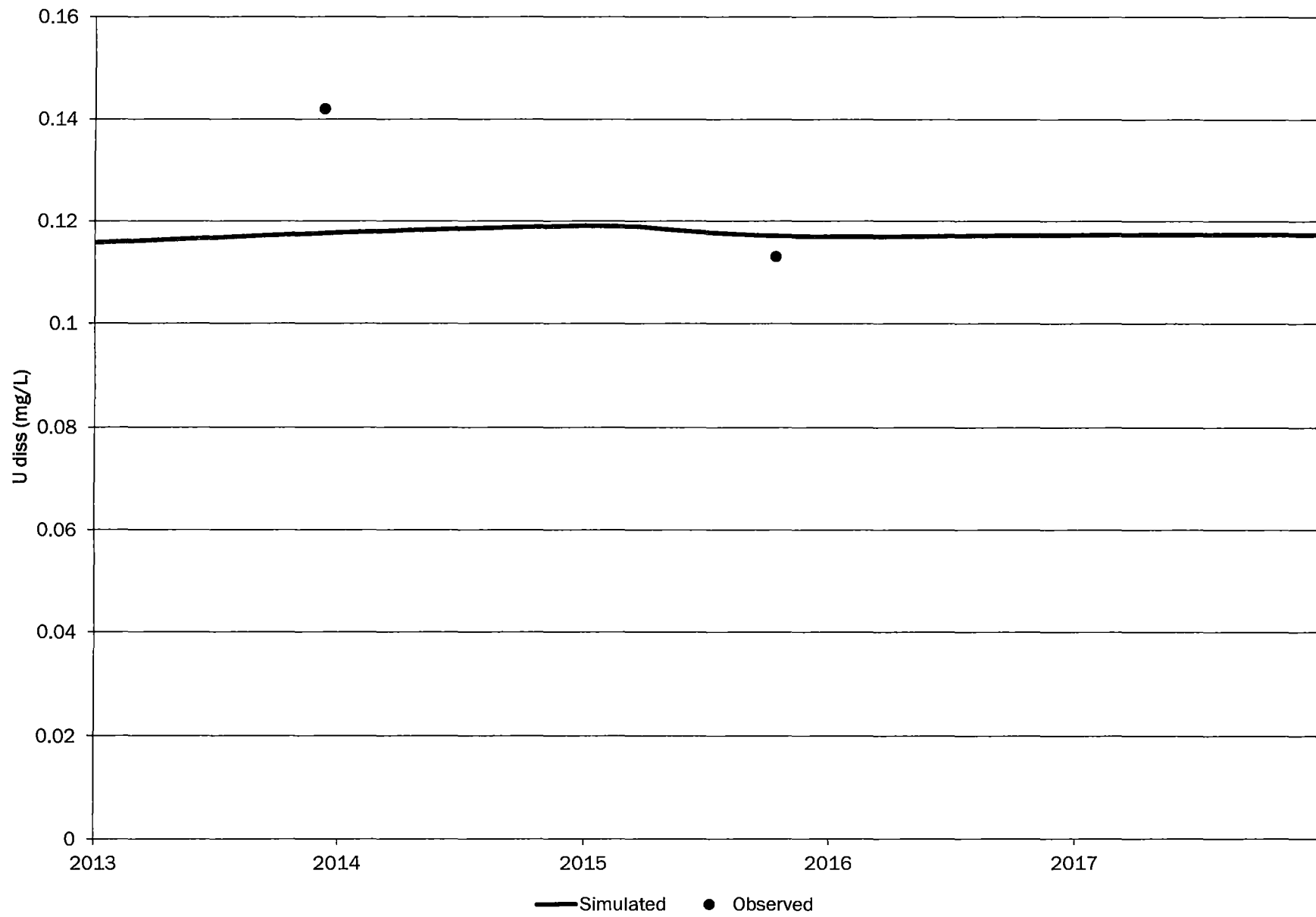
0931-UC

U diss (mg/L)

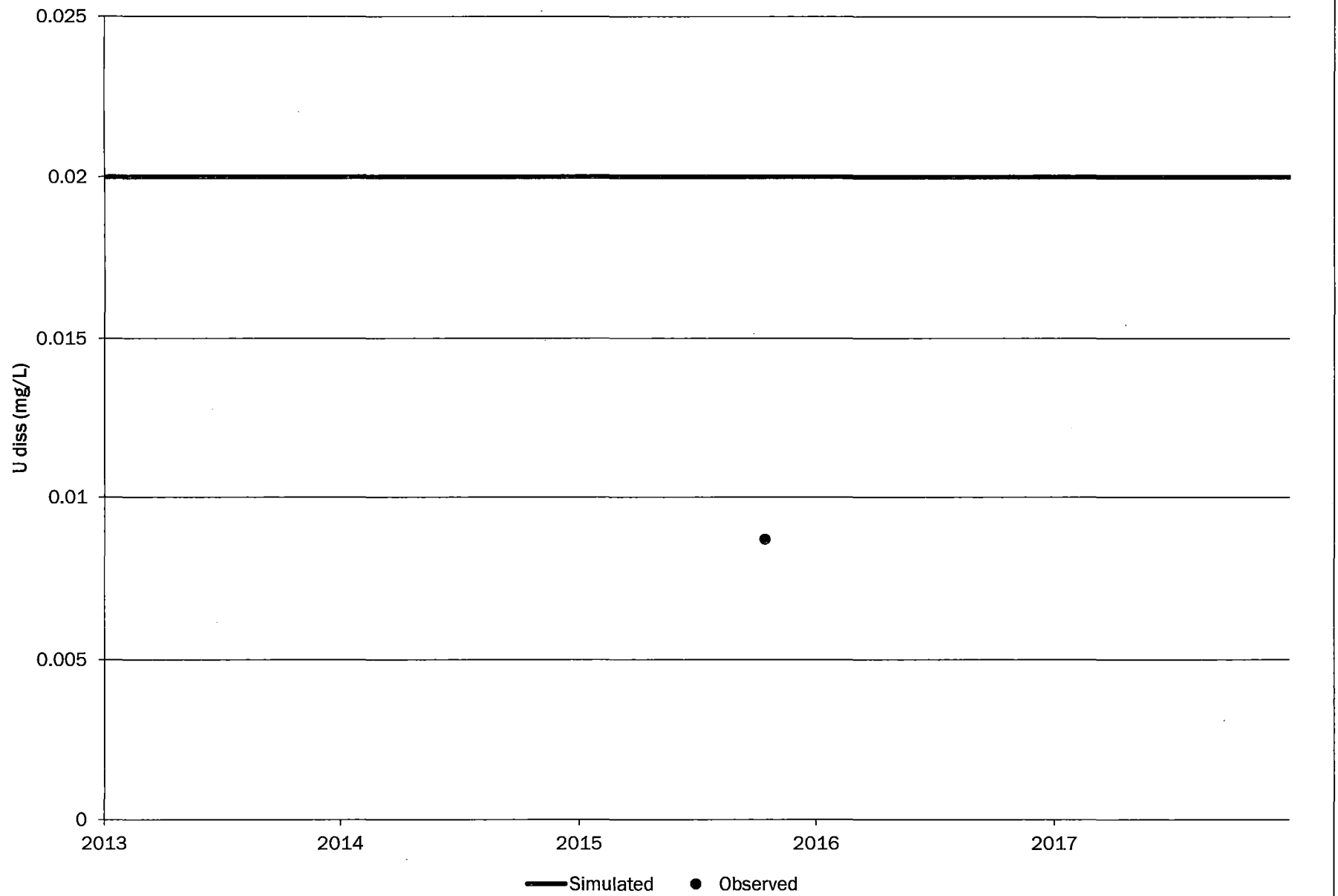
Simulated Observed

Year	Simulated (mg/L)	Observed (mg/L)
2013	0.001	
2014	0.001	
2015	0.001	
2016	0.001	
2017	0.001	
2018	0.001	
2019	0.001	
2020	0.001	
2021	0.001	
2022	0.001	
2023	0.001	
2024	0.001	
2025	0.001	
2026	0.001	
2027	0.001	
2028	0.001	
2029	0.001	
2030	0.001	
2031	0.001	
2032	0.001	
2033	0.001	
2034	0.001	
2035	0.001	
2036	0.001	
2037	0.001	
2038	0.001	
2039	0.001	
2040	0.001	
2041	0.001	
2042	0.001	
2043	0.001	
2044	0.001	
2045	0.001	
2046	0.001	
2047	0.001	
2048	0.001	
2049	0.001	
2050	0.001	
2051	0.001	
2052	0.001	
2053	0.001	
2054	0.001	
2055	0.001	
2056	0.001	
2057	0.001	
2058	0.001	
2059	0.001	
2060	0.001	
2061	0.001	
2062	0.001	
2063	0.001	
2064	0.001	
2065	0.001	
2066	0.001	
2067	0.001	
2068	0.001	
2069	0.001	
2070	0.001	
2071	0.001	
2072	0.001	
2073	0.001	
2074	0.001	
2075	0.001	
2076	0.001	
2077	0.001	
2078	0.001	
2079	0.001	
2080	0.001	
2081	0.001	
2082	0.001	
2083	0.001	
2084	0.001	
2085	0.001	
2086	0.001	
2087	0.001	
2088	0.001	
2089	0.001	
2090	0.001	
2091	0.001	
2092	0.001	
2093	0.001	
2094	0.001	
2095	0.001	
2096	0.001	
2097	0.001	
2098	0.001	
2099	0.001	
2100	0.001	

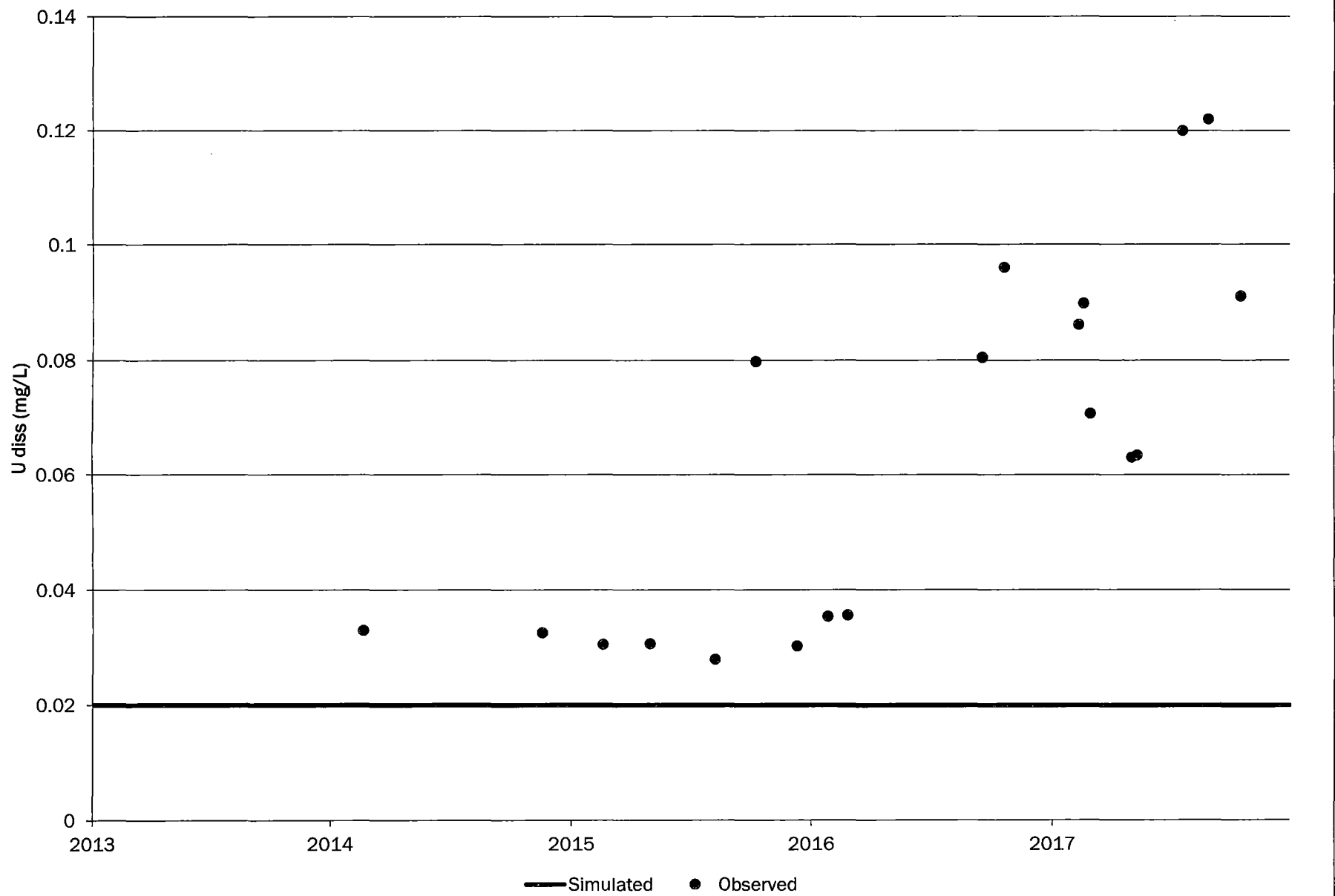
0935-AI



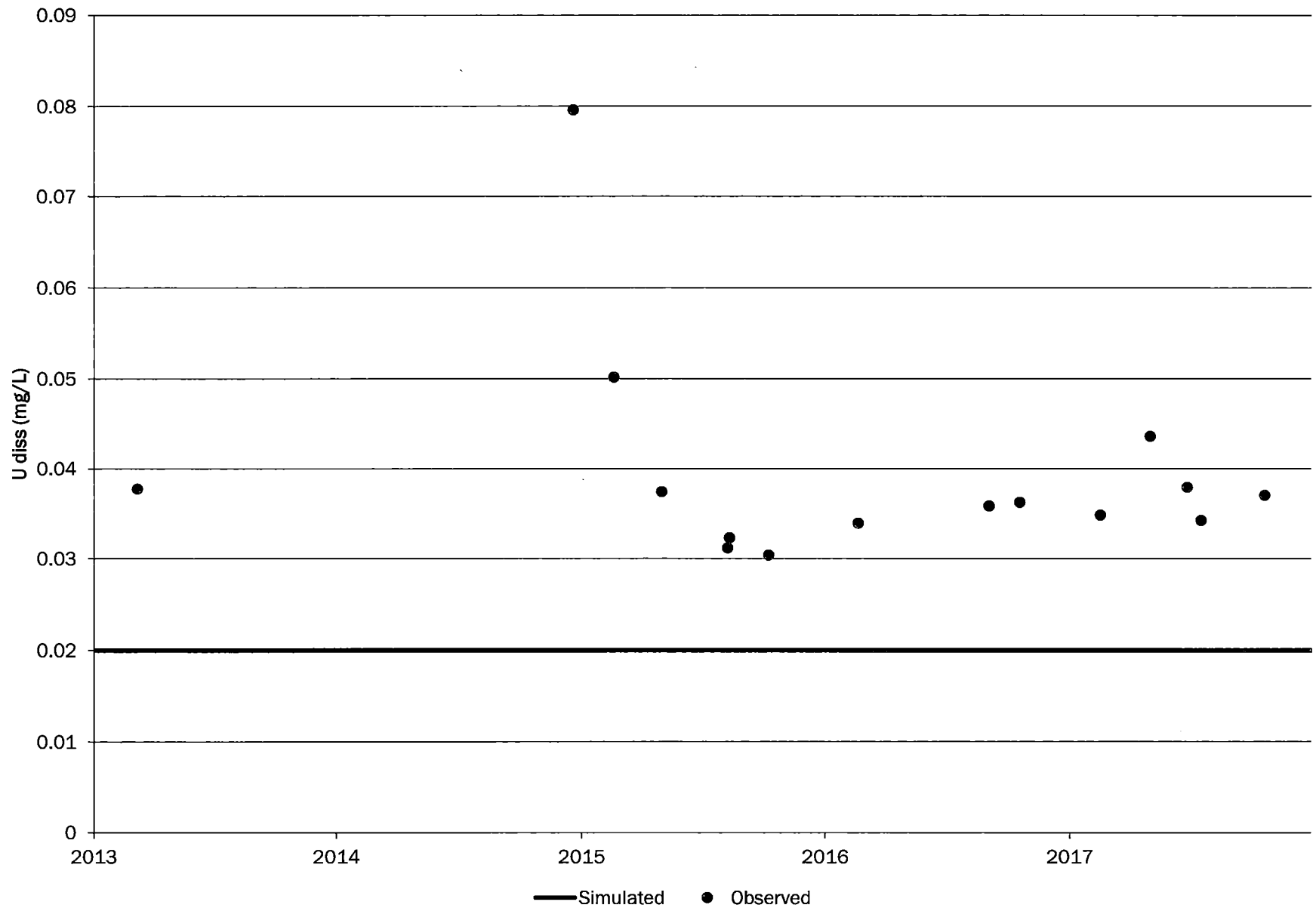
0938-SA



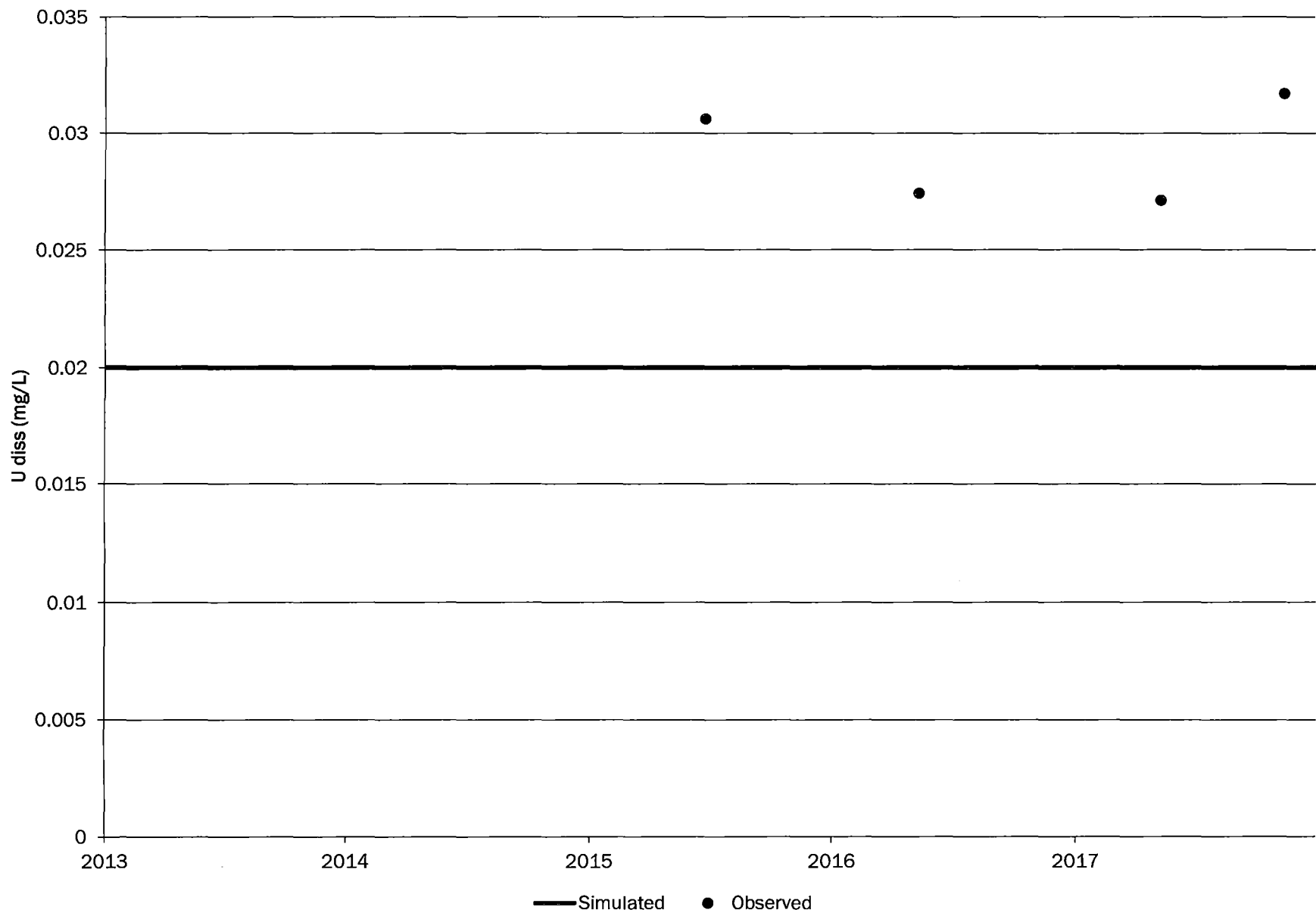
0943-SA



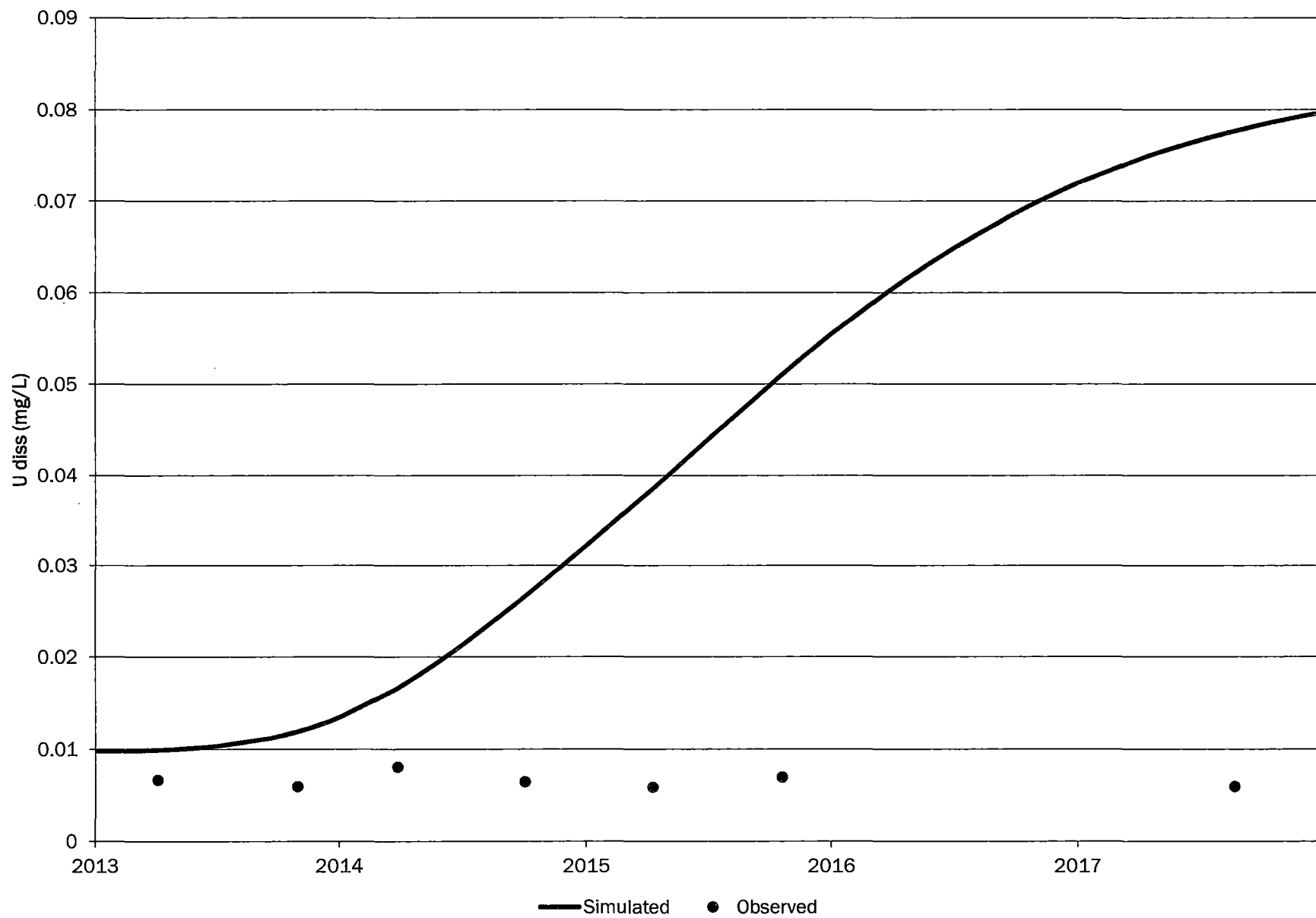
0951R-SA



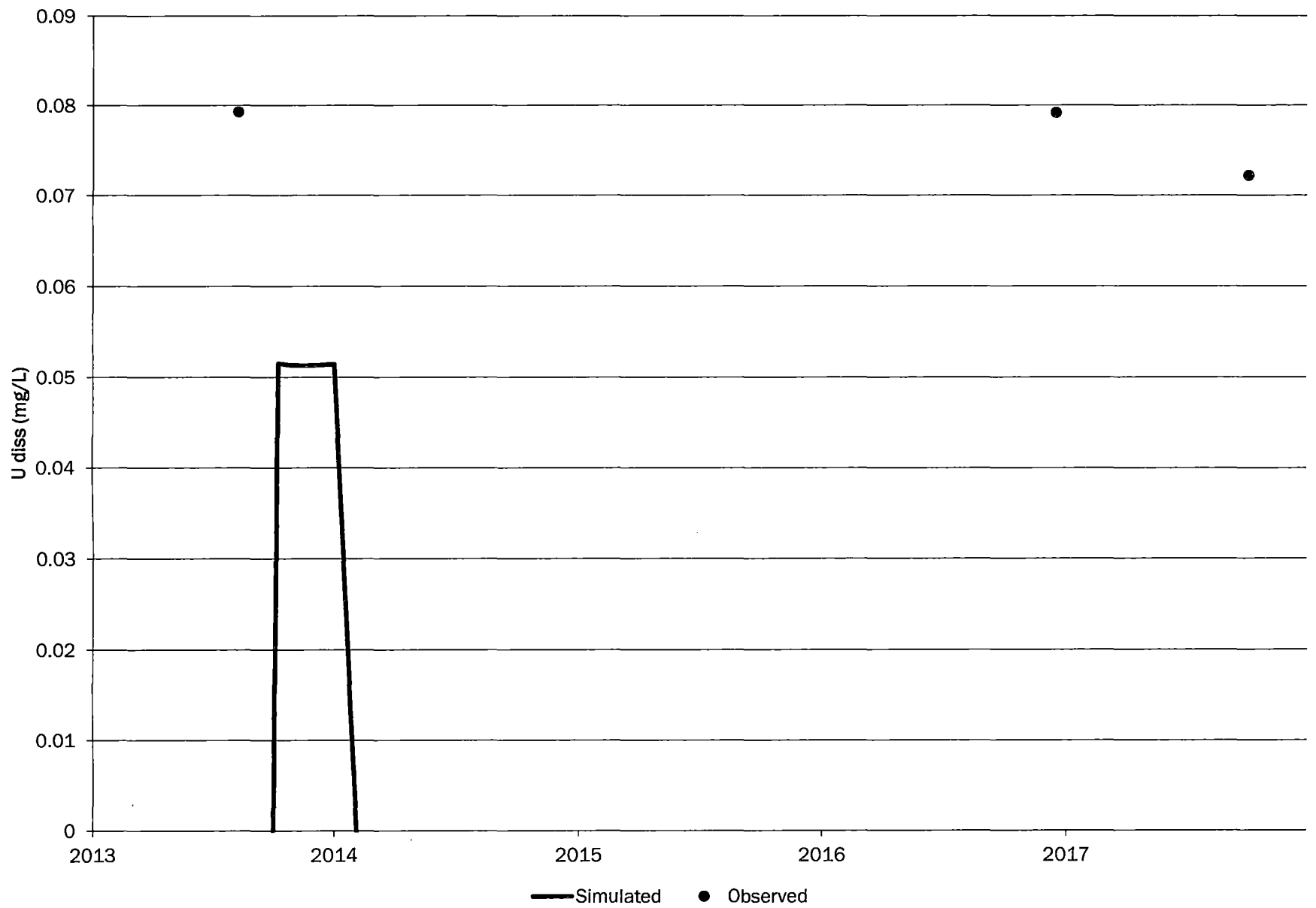
0951-SA



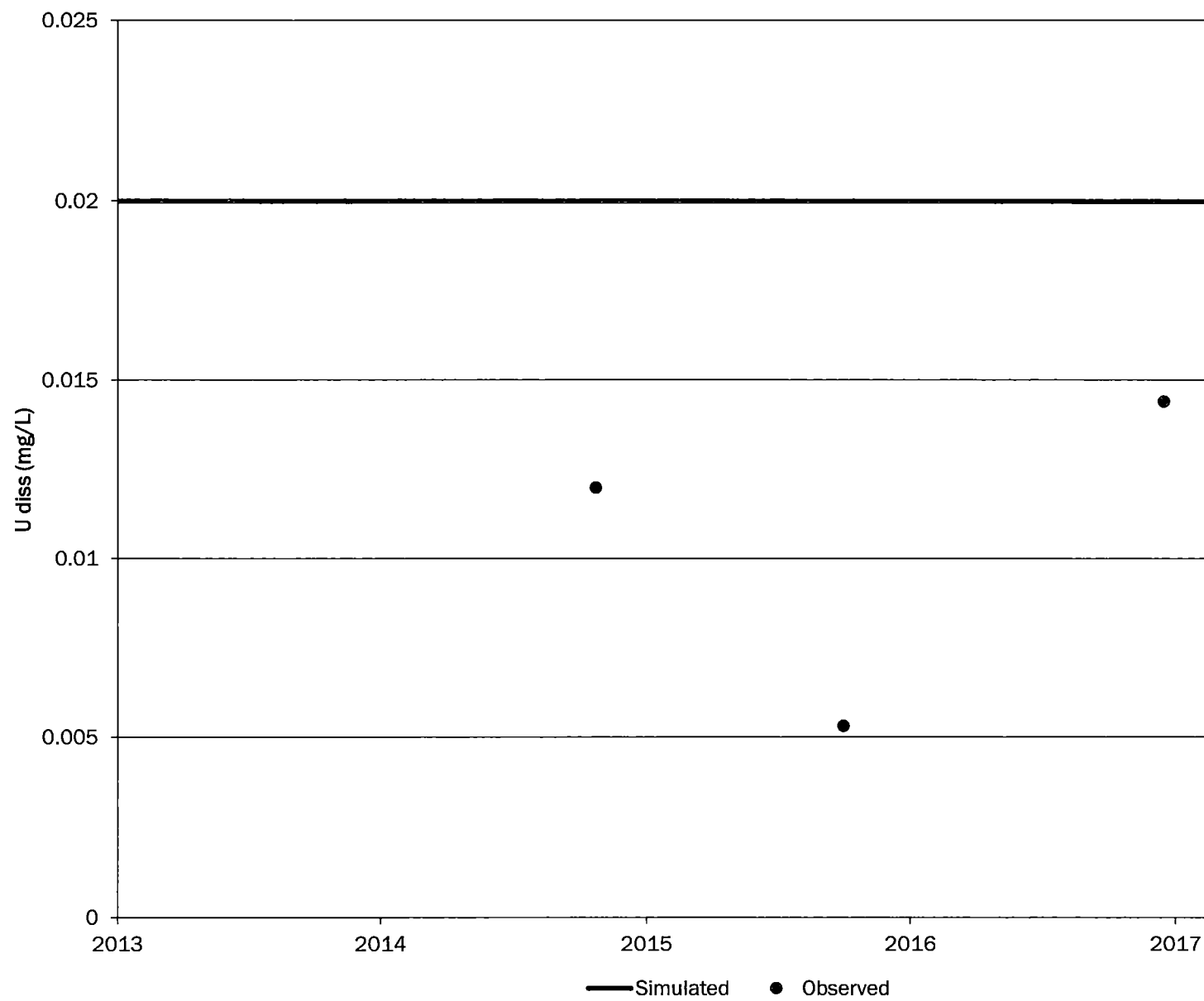
0994-AI



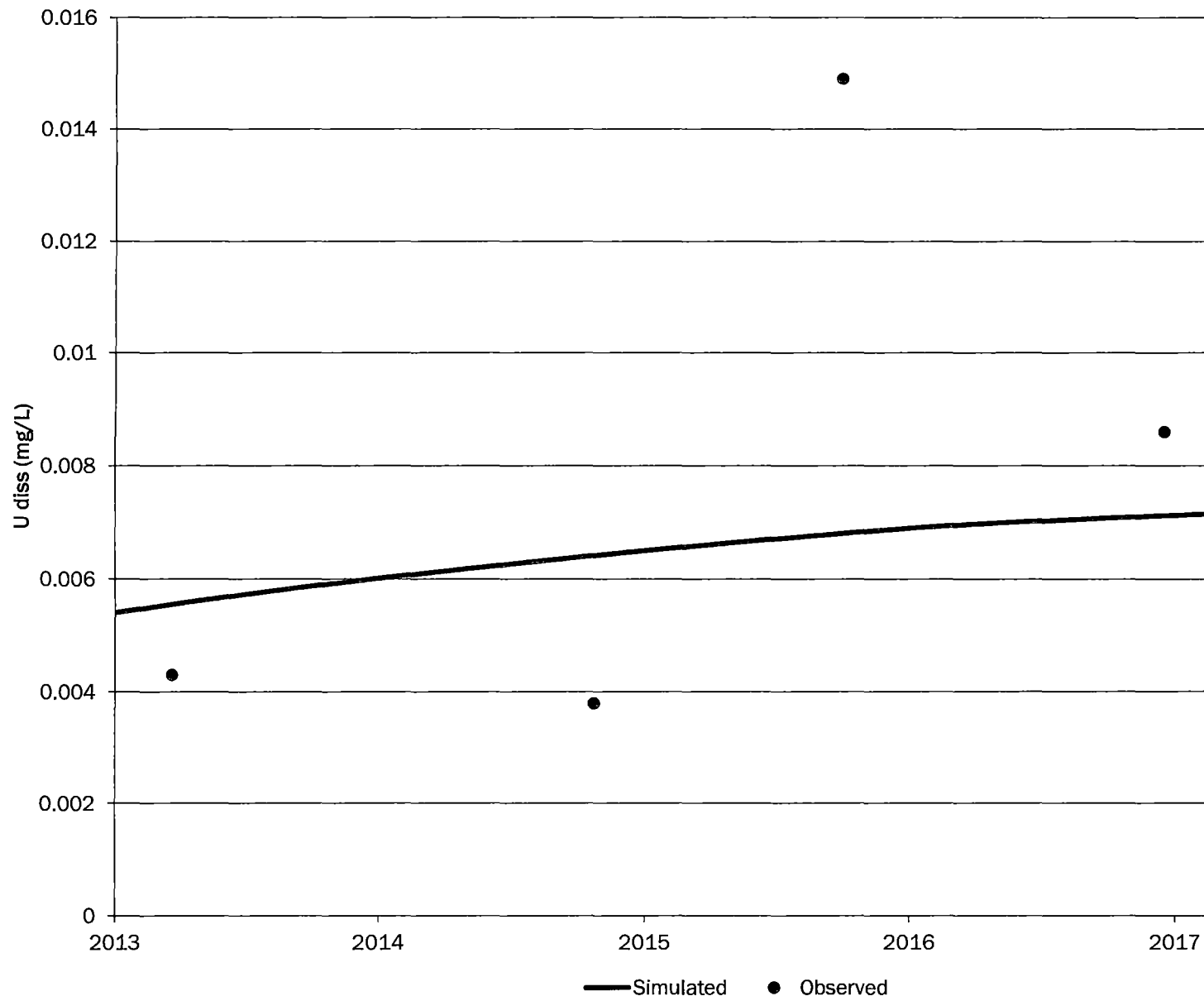
0996-AI



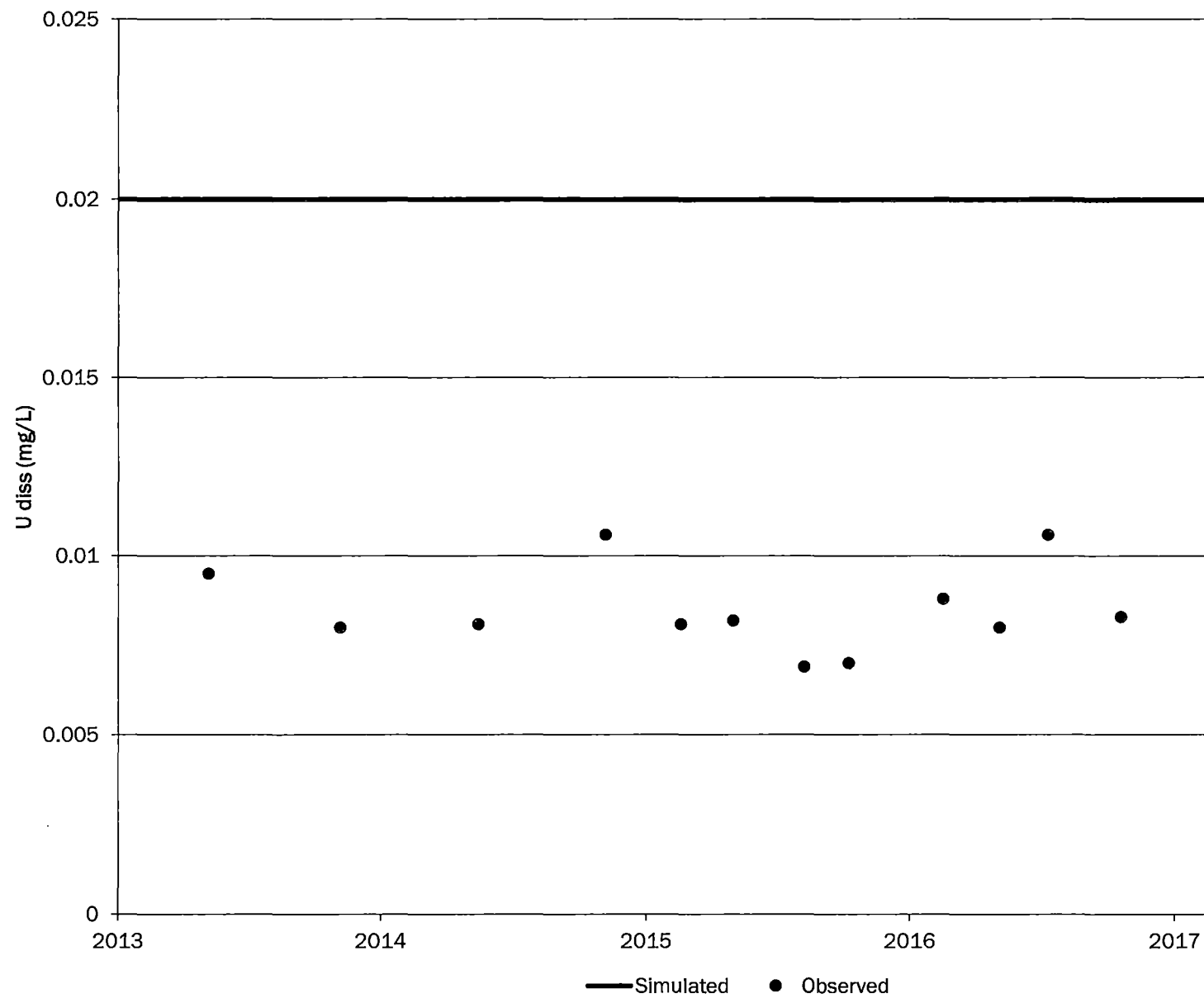
0998-SA



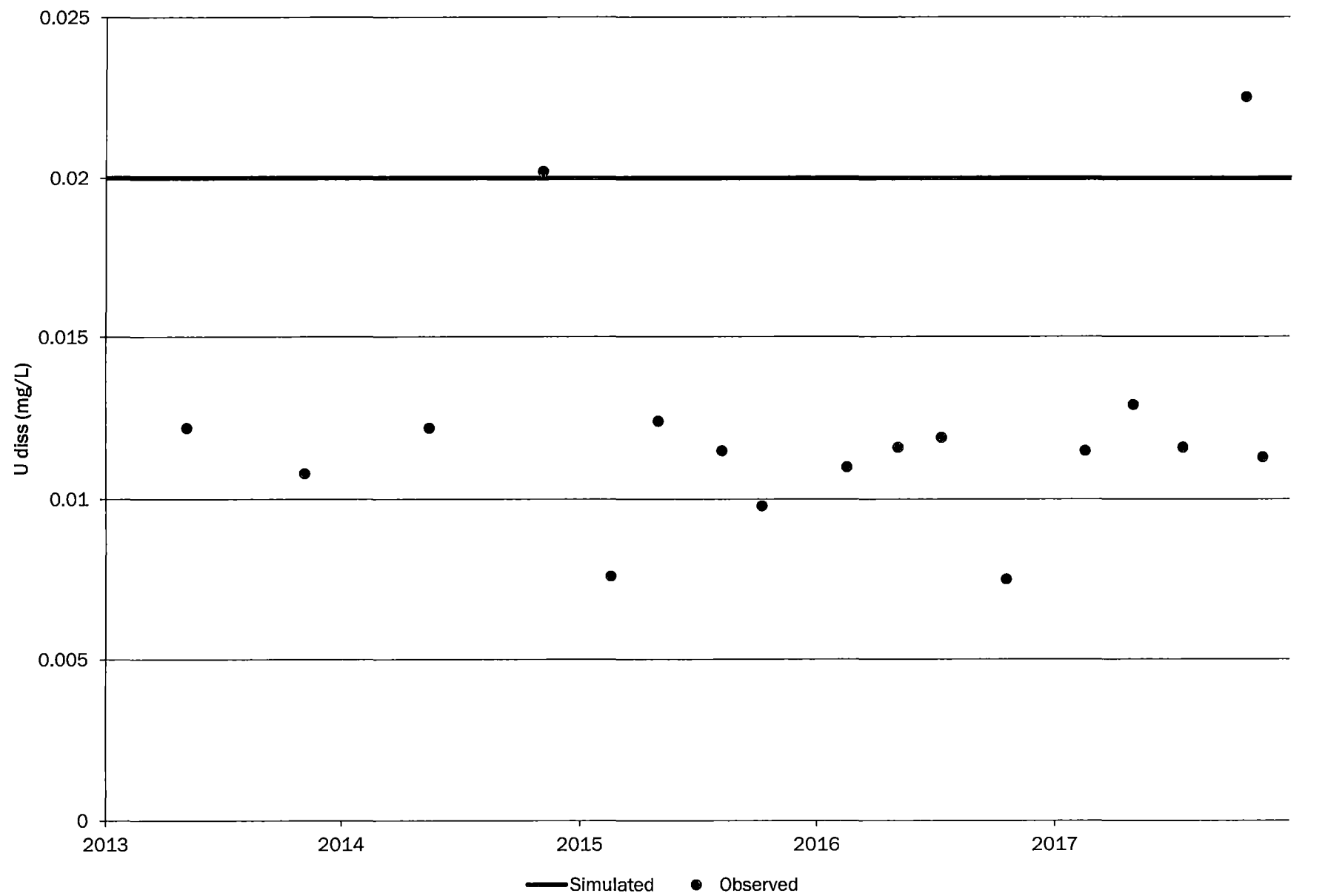
0999-AI



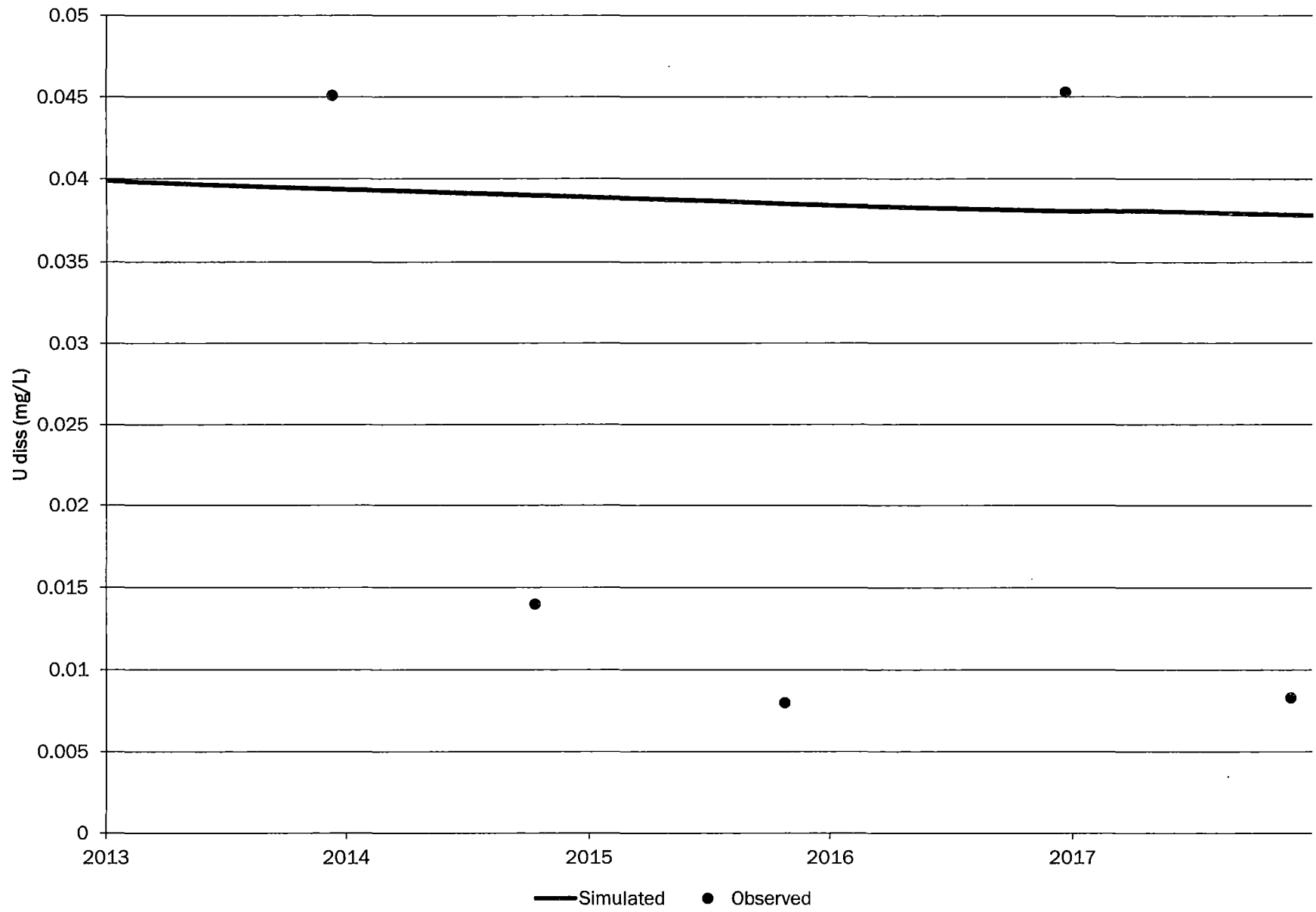
#1 Deepwell-SA



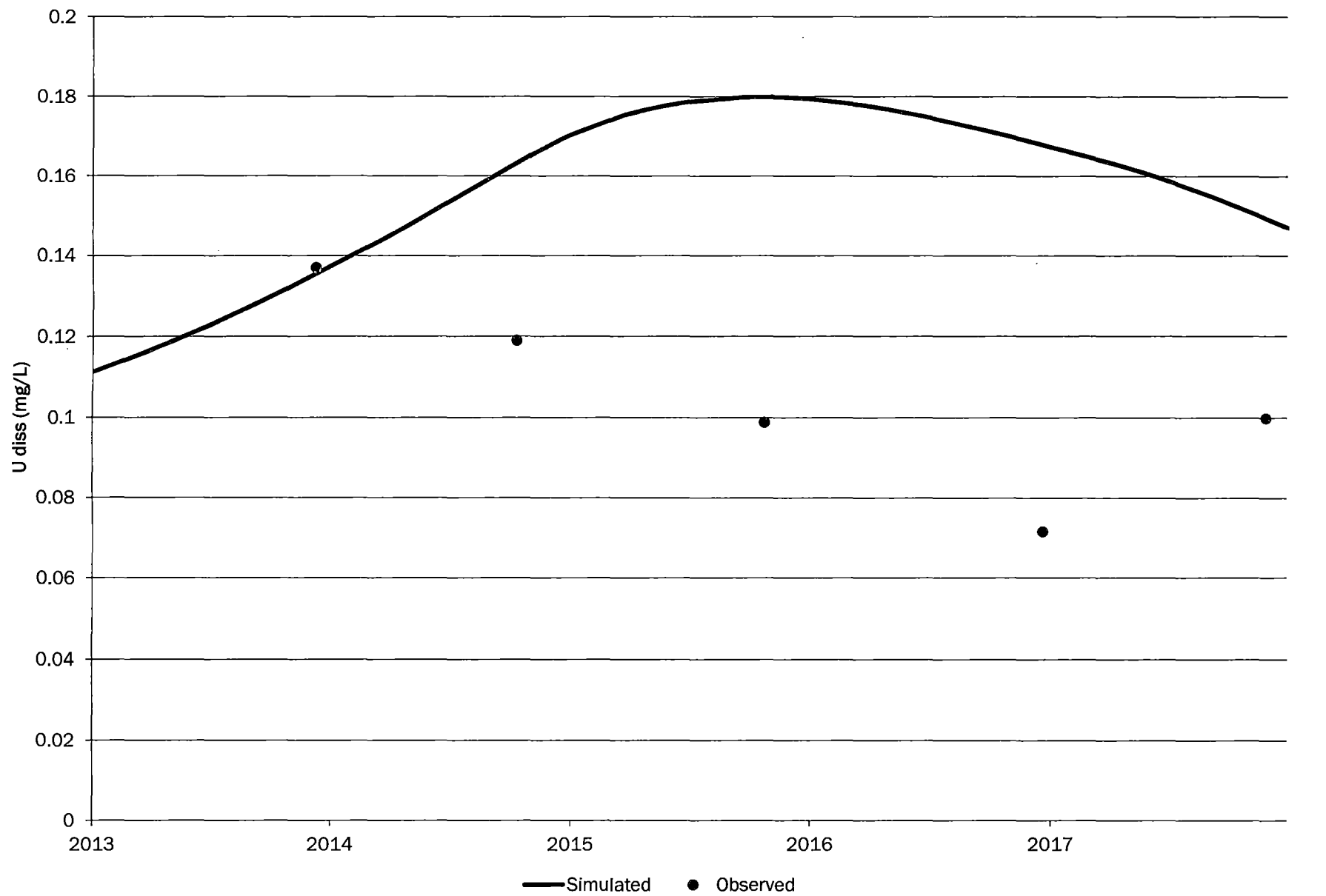
#2 Deepwell-SA



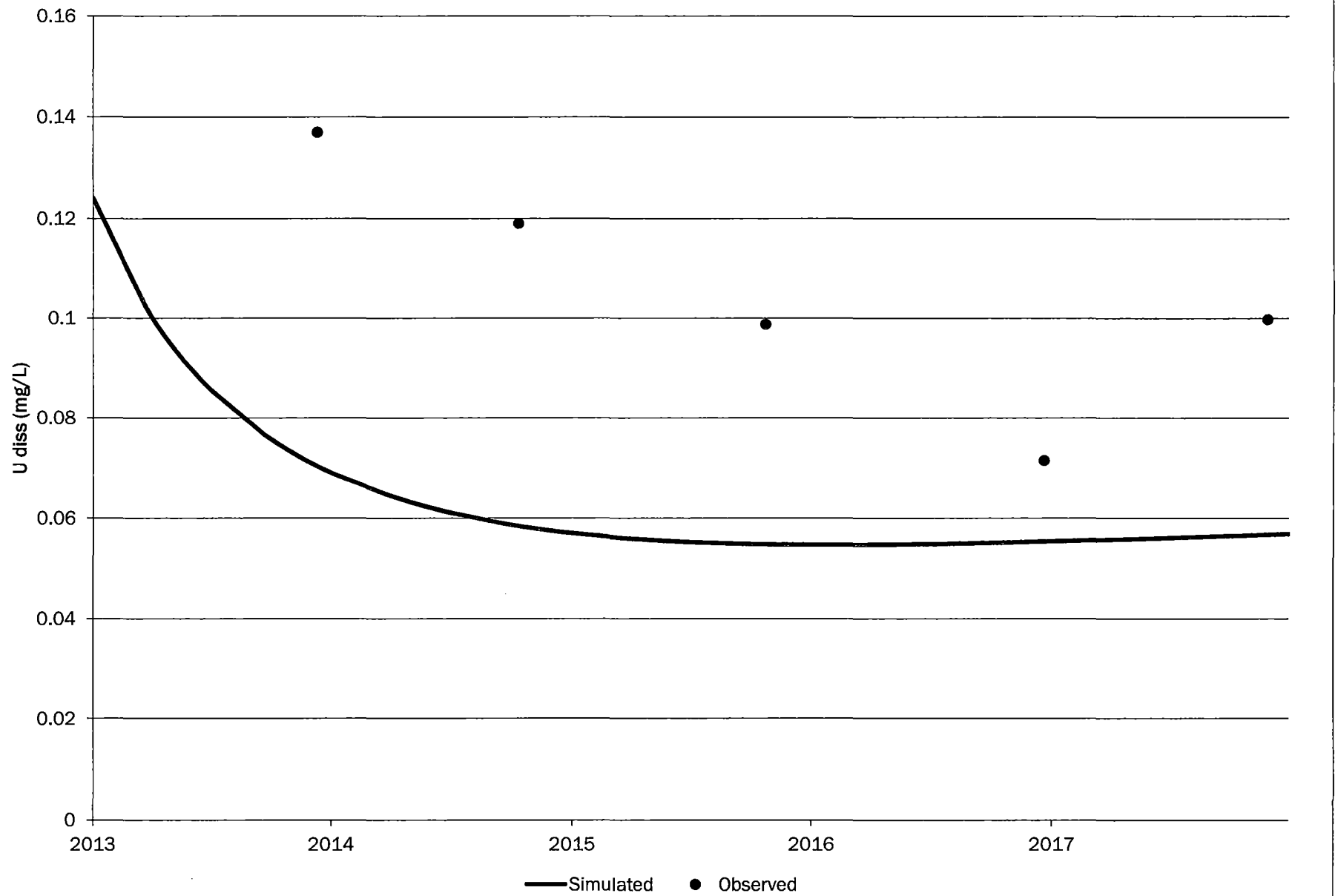
ACW-MC



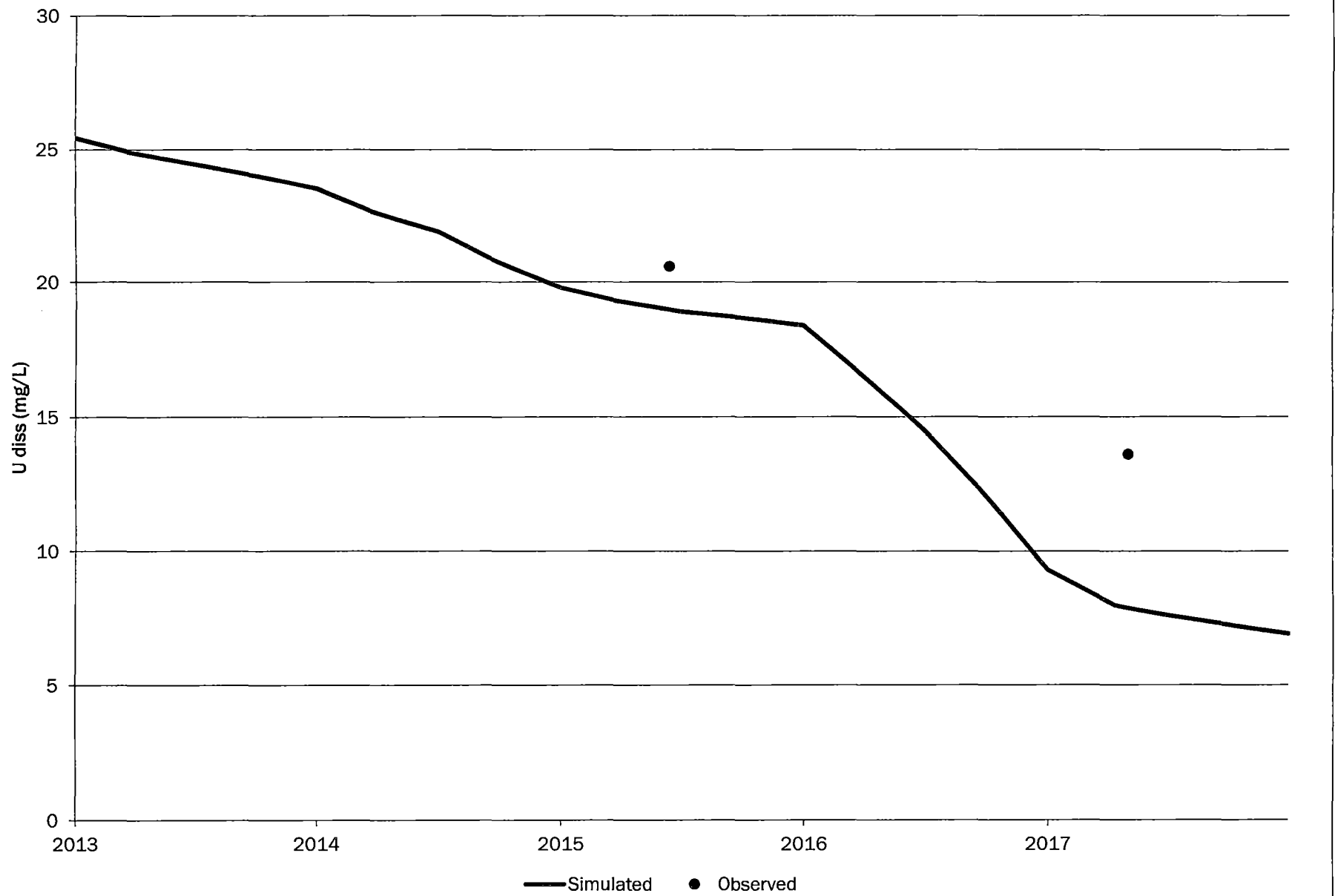
AW-AI



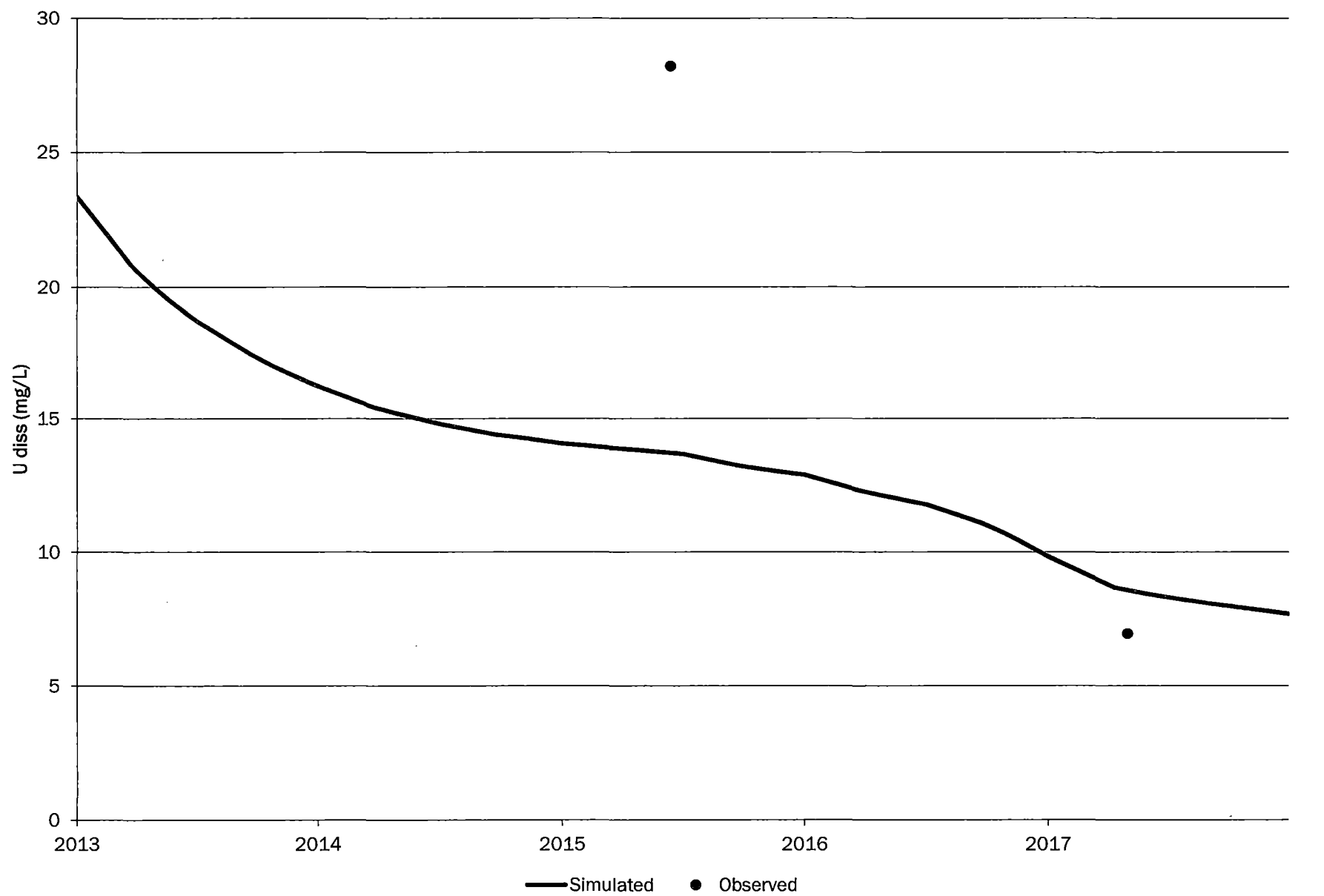
AW-UC



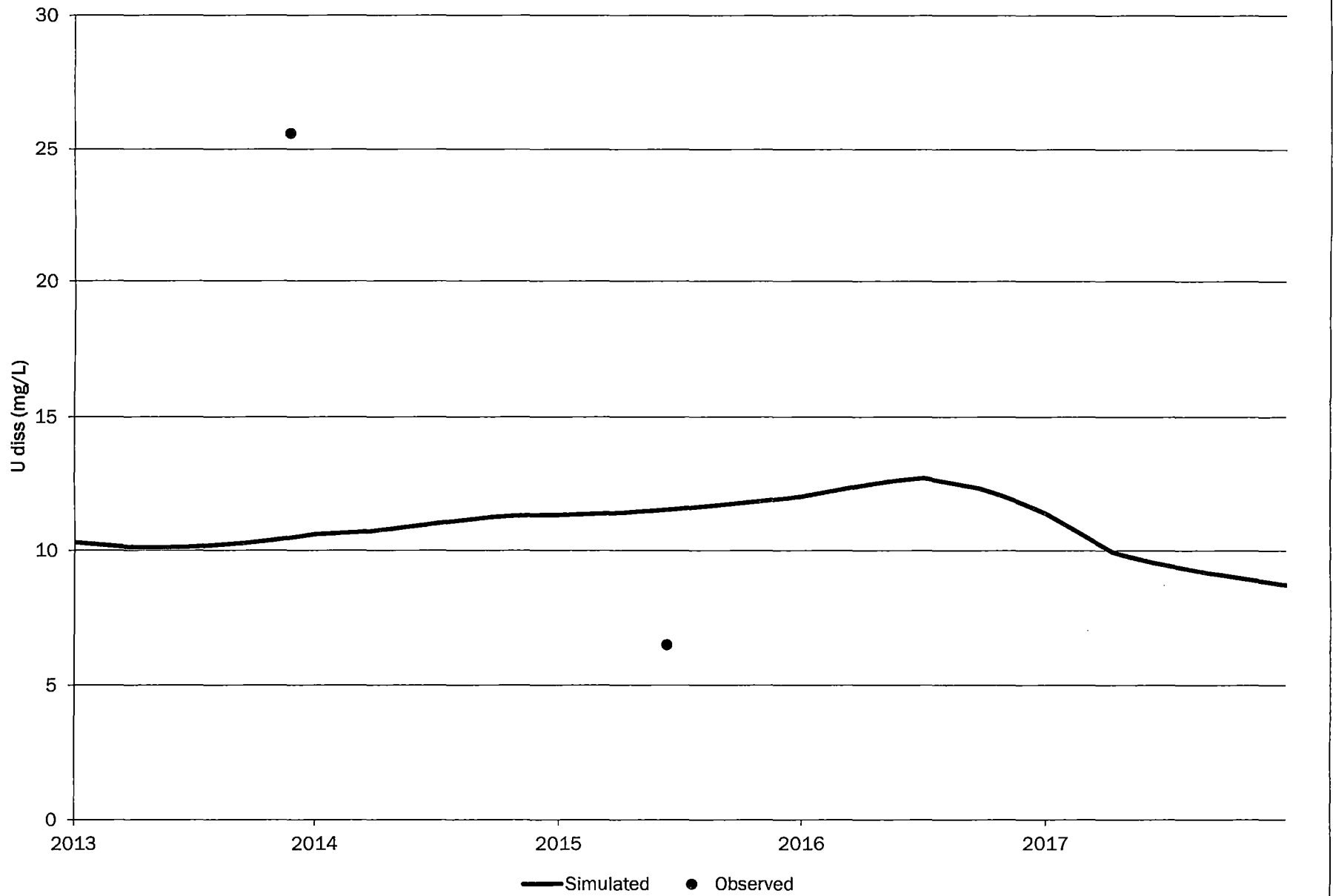
B4-AI



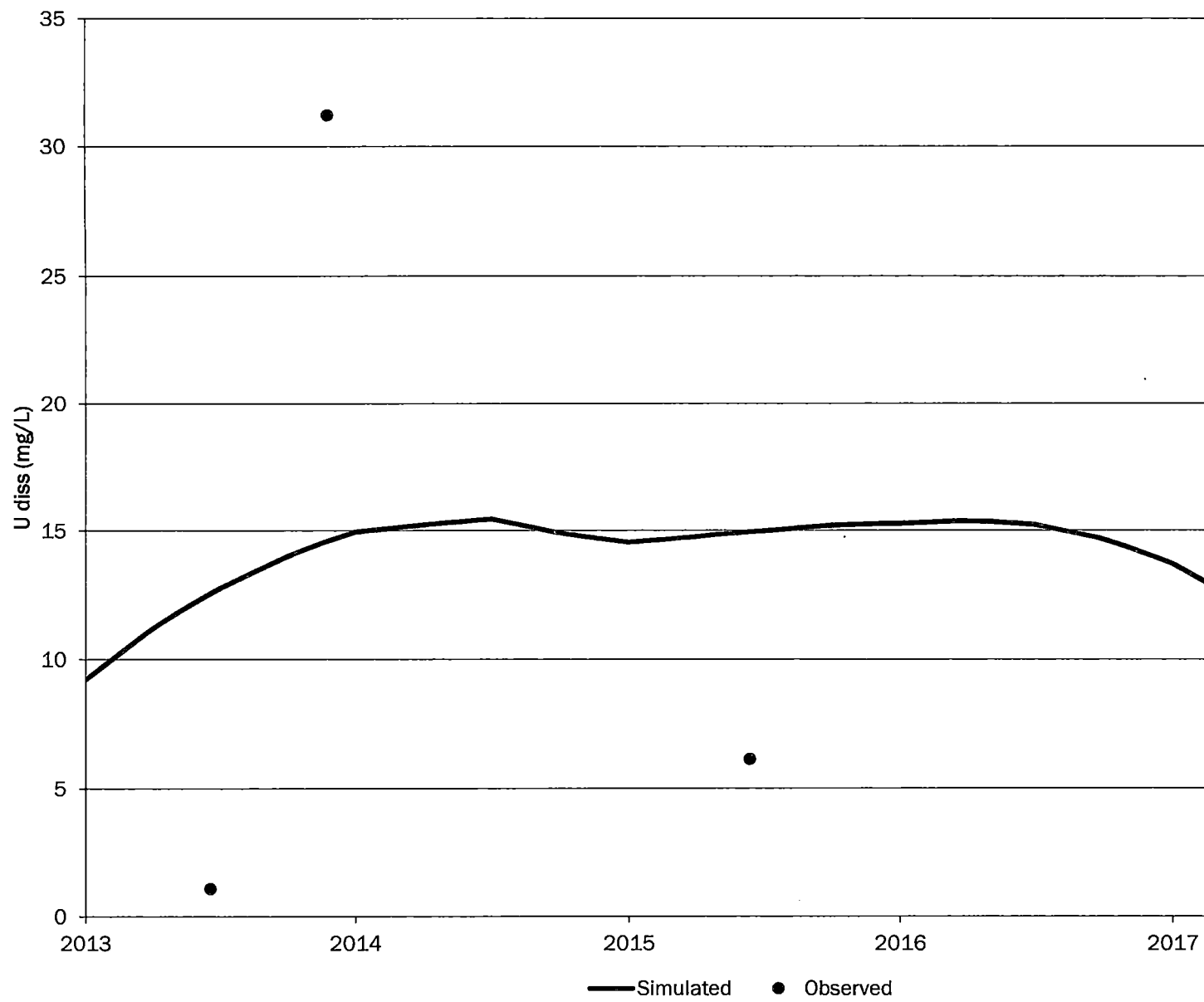
B5-AI



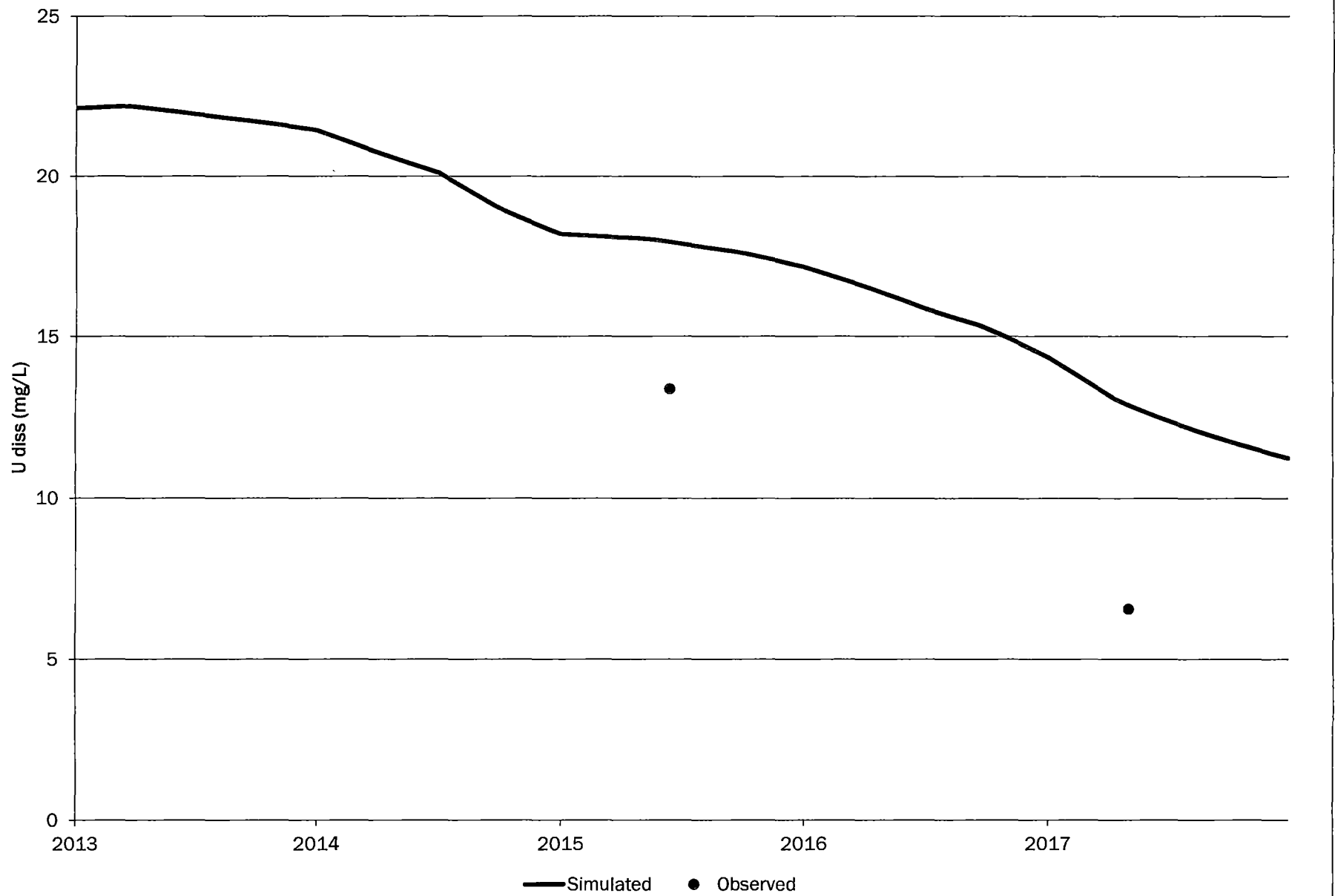
B6-AI



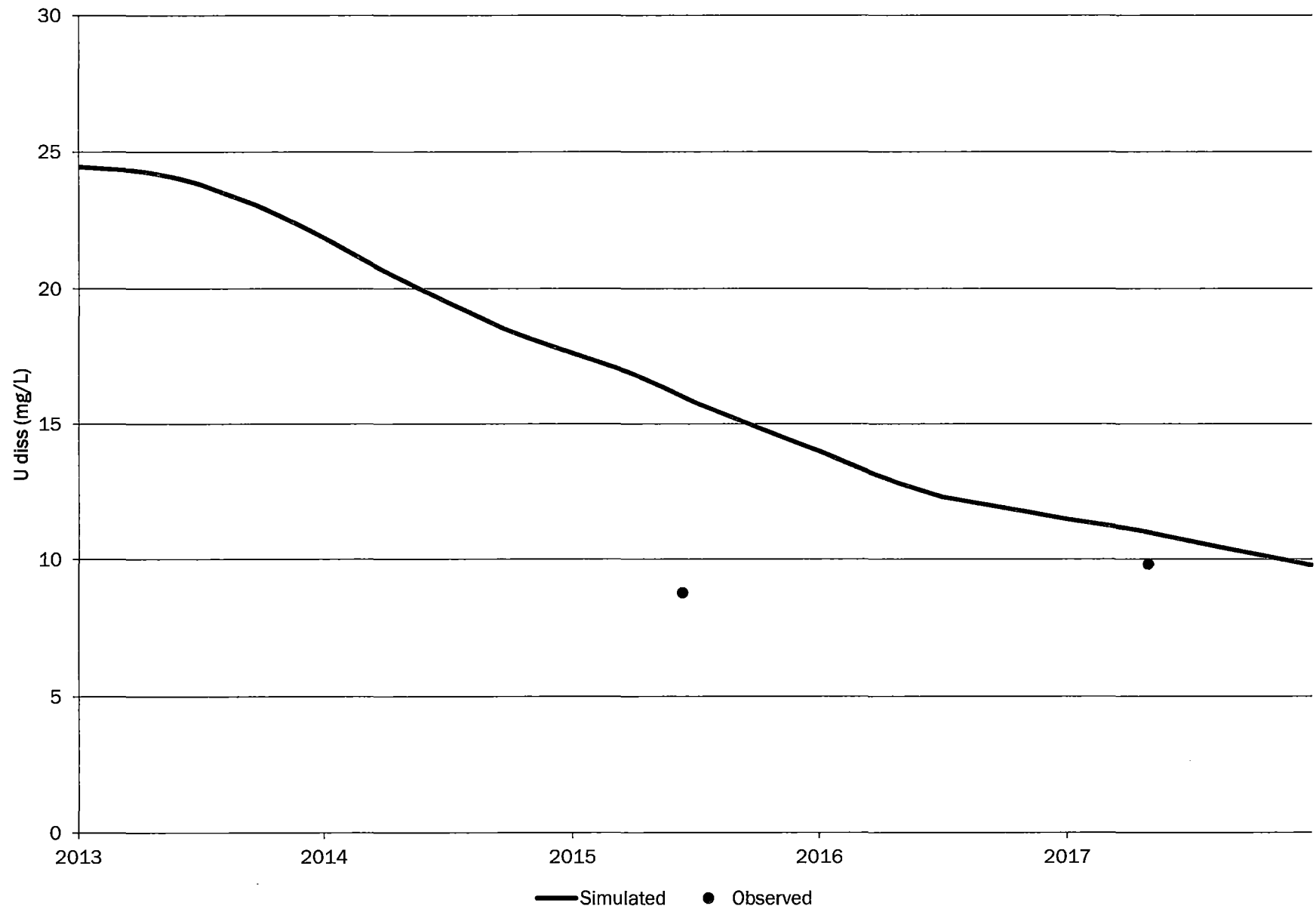
B7-AI



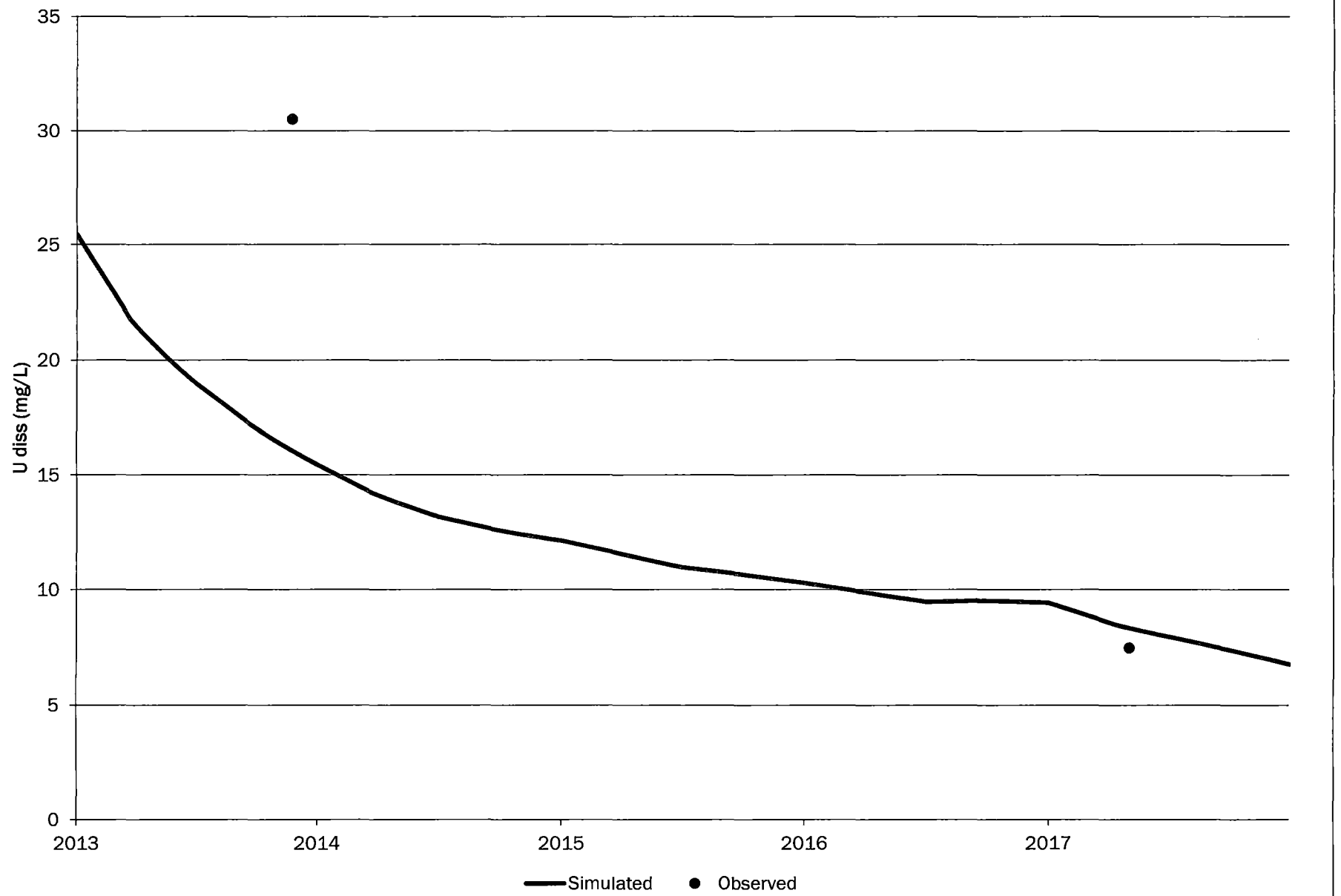
B8-AI



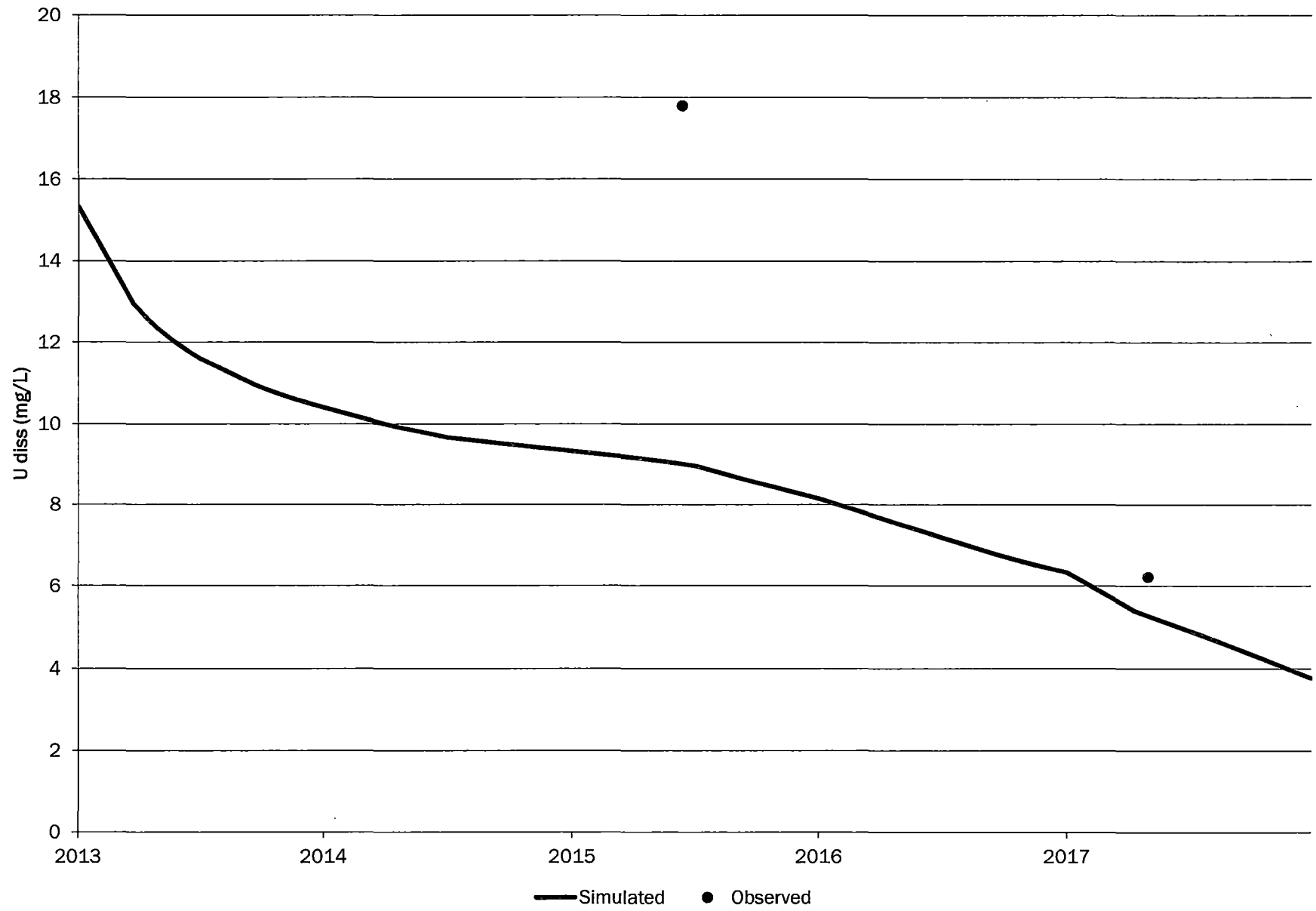
B9-AI



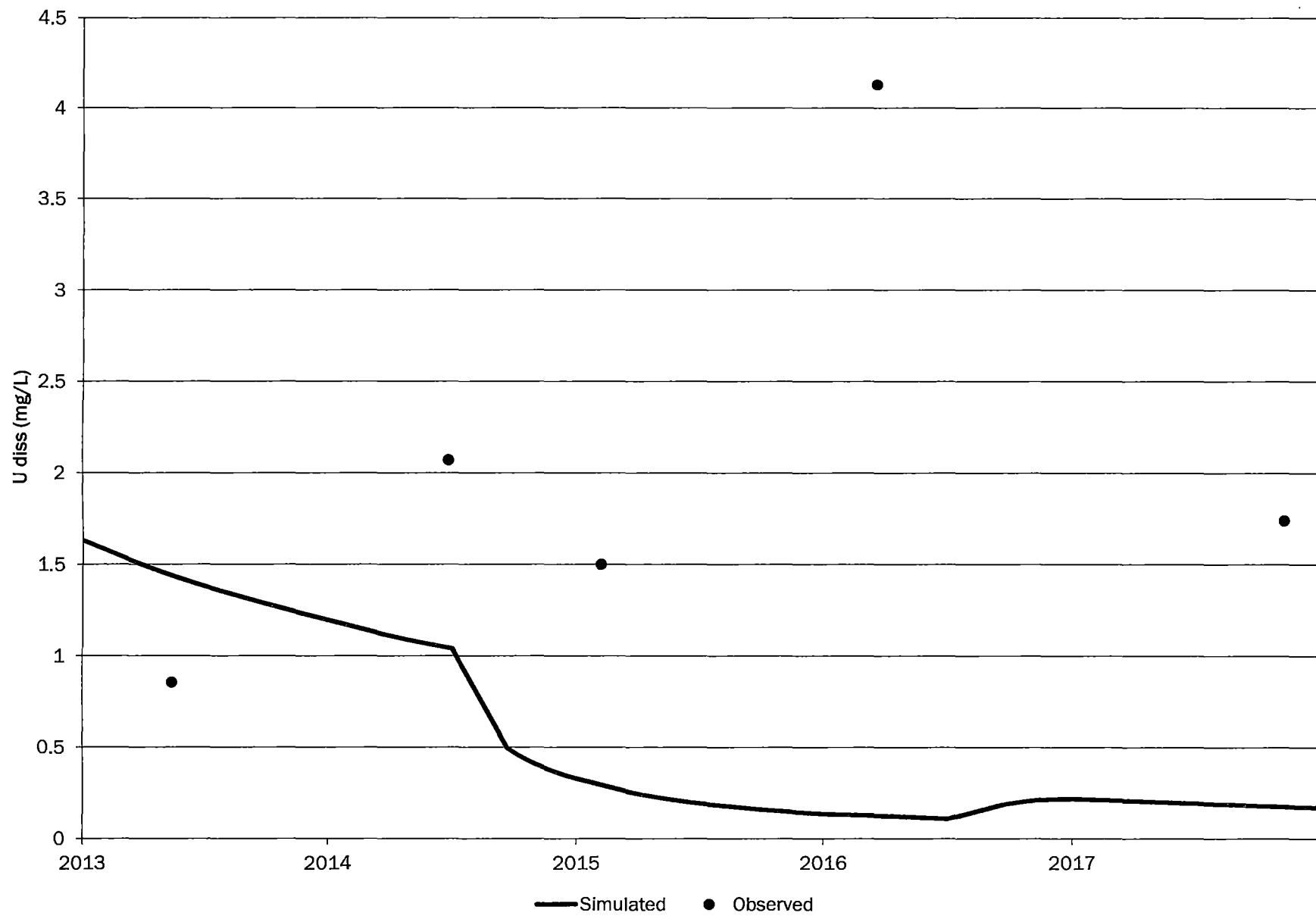
B10-AI



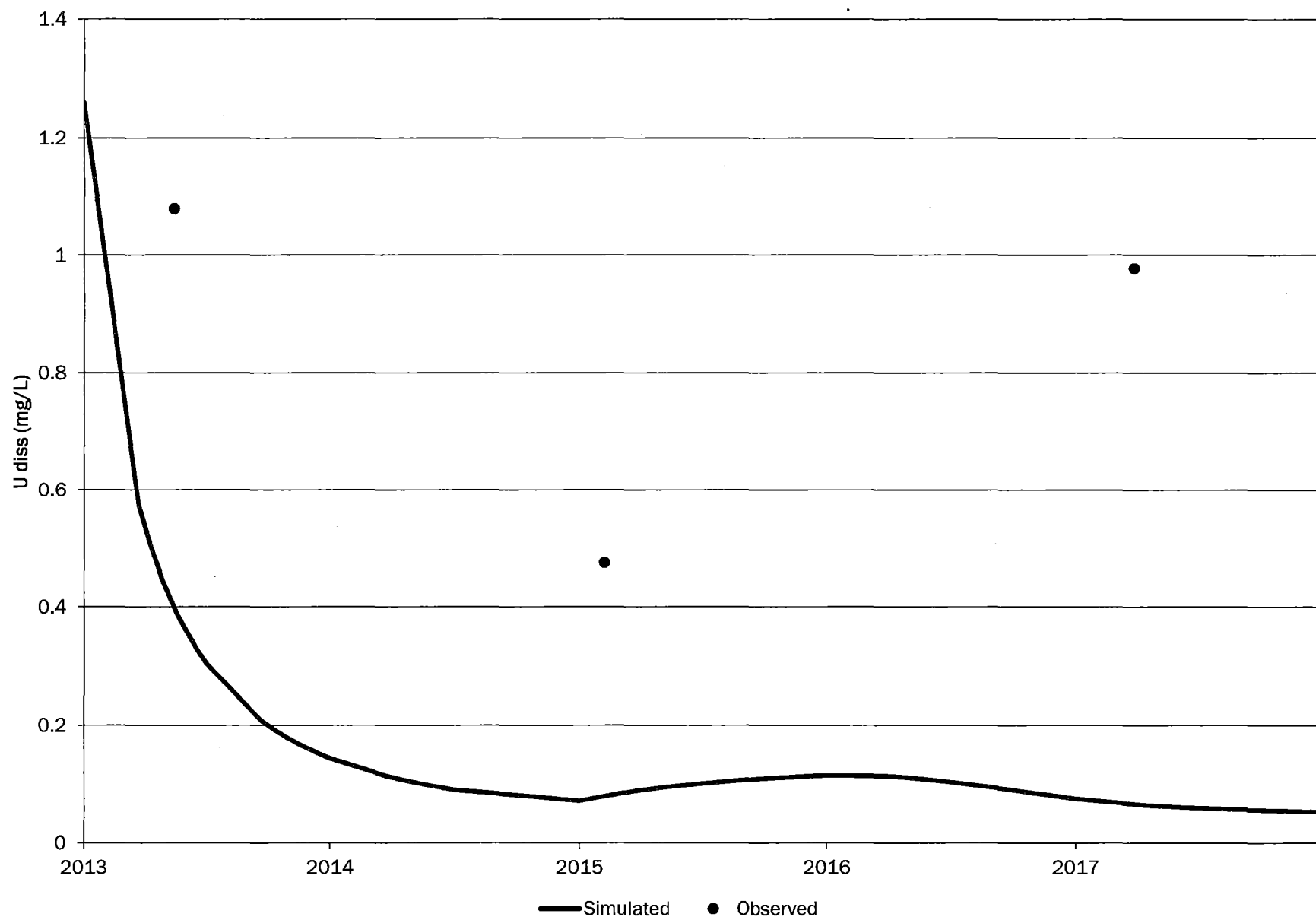
B11-AI



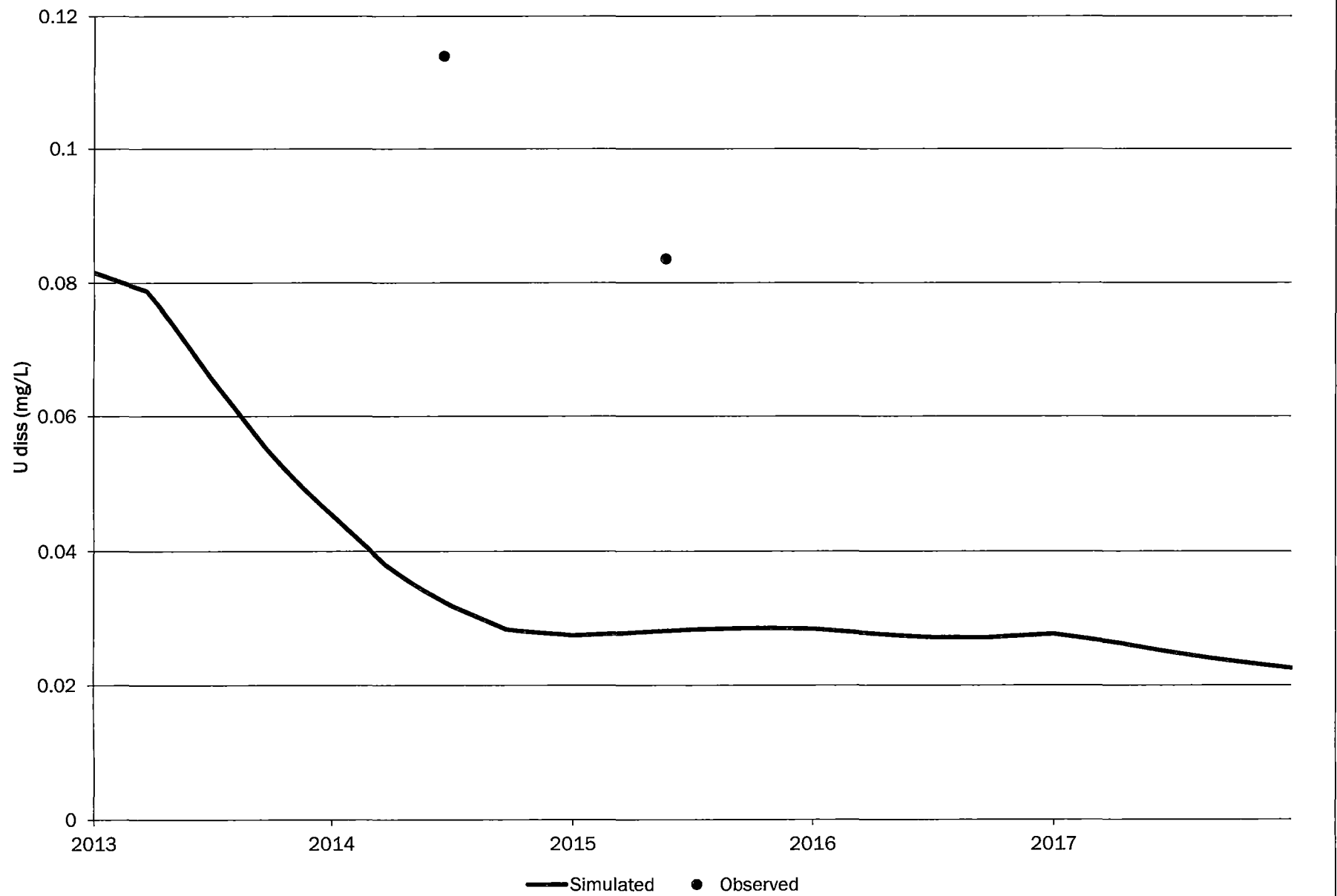
B12-AI



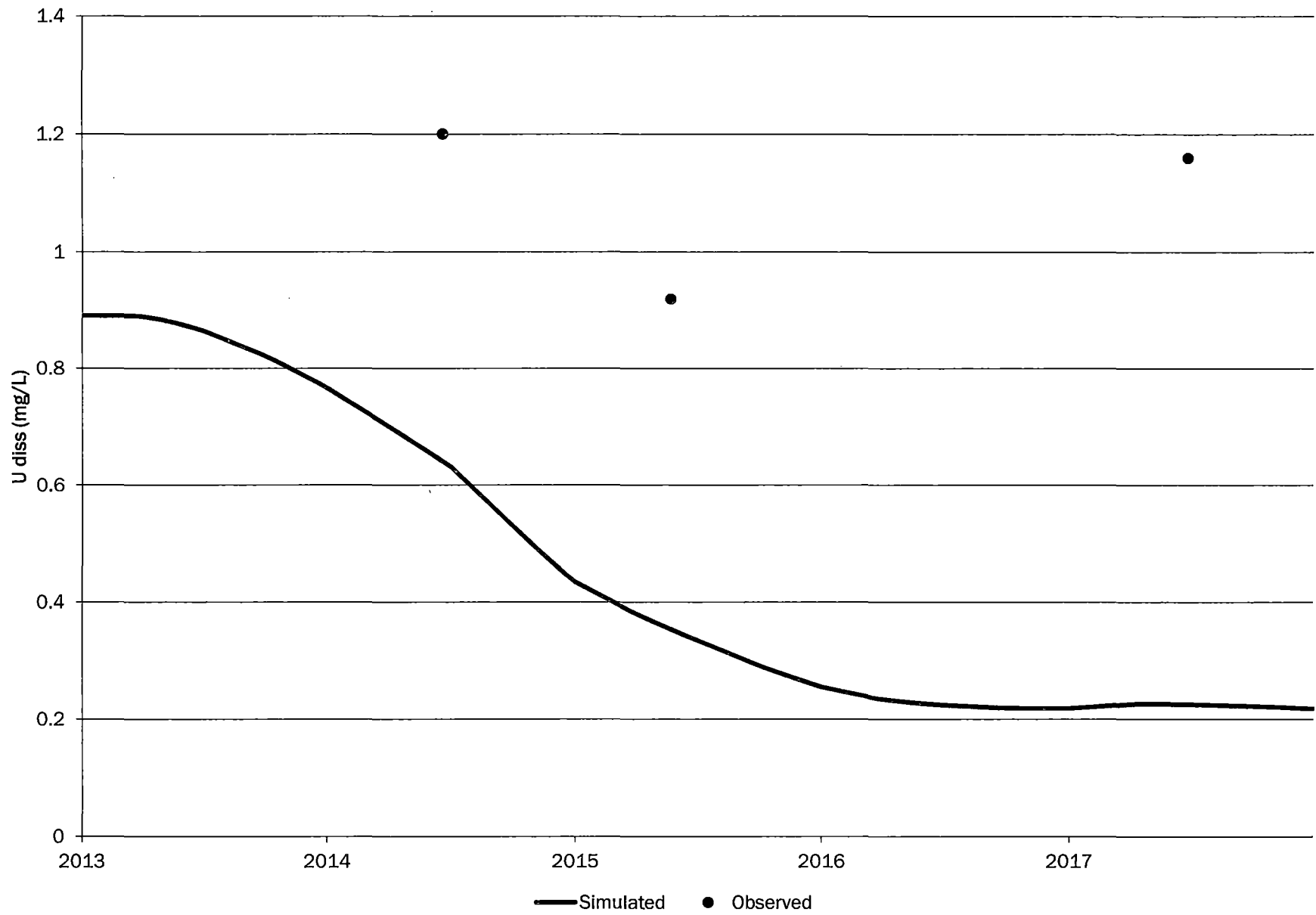
B13-AI



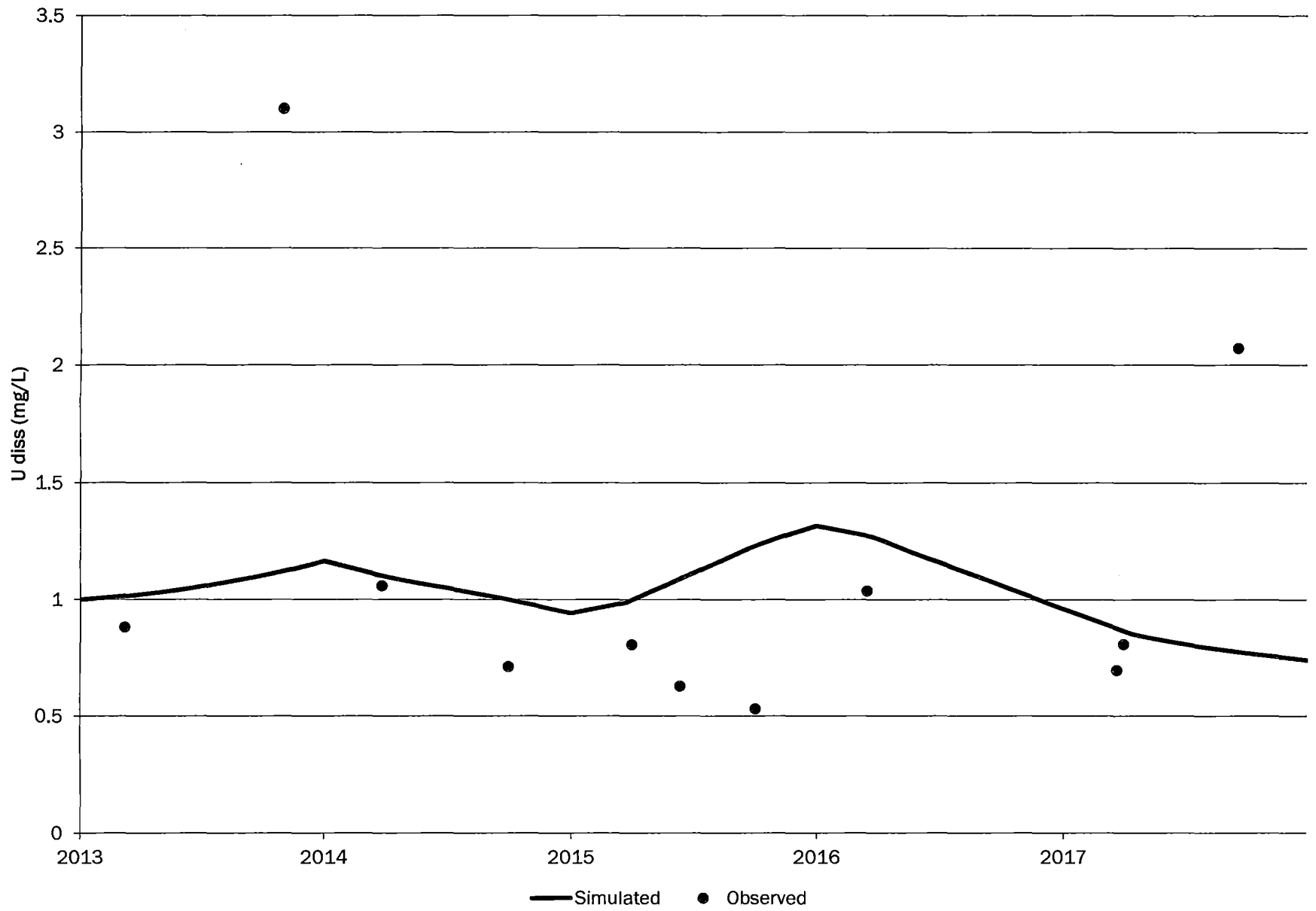
B-AI



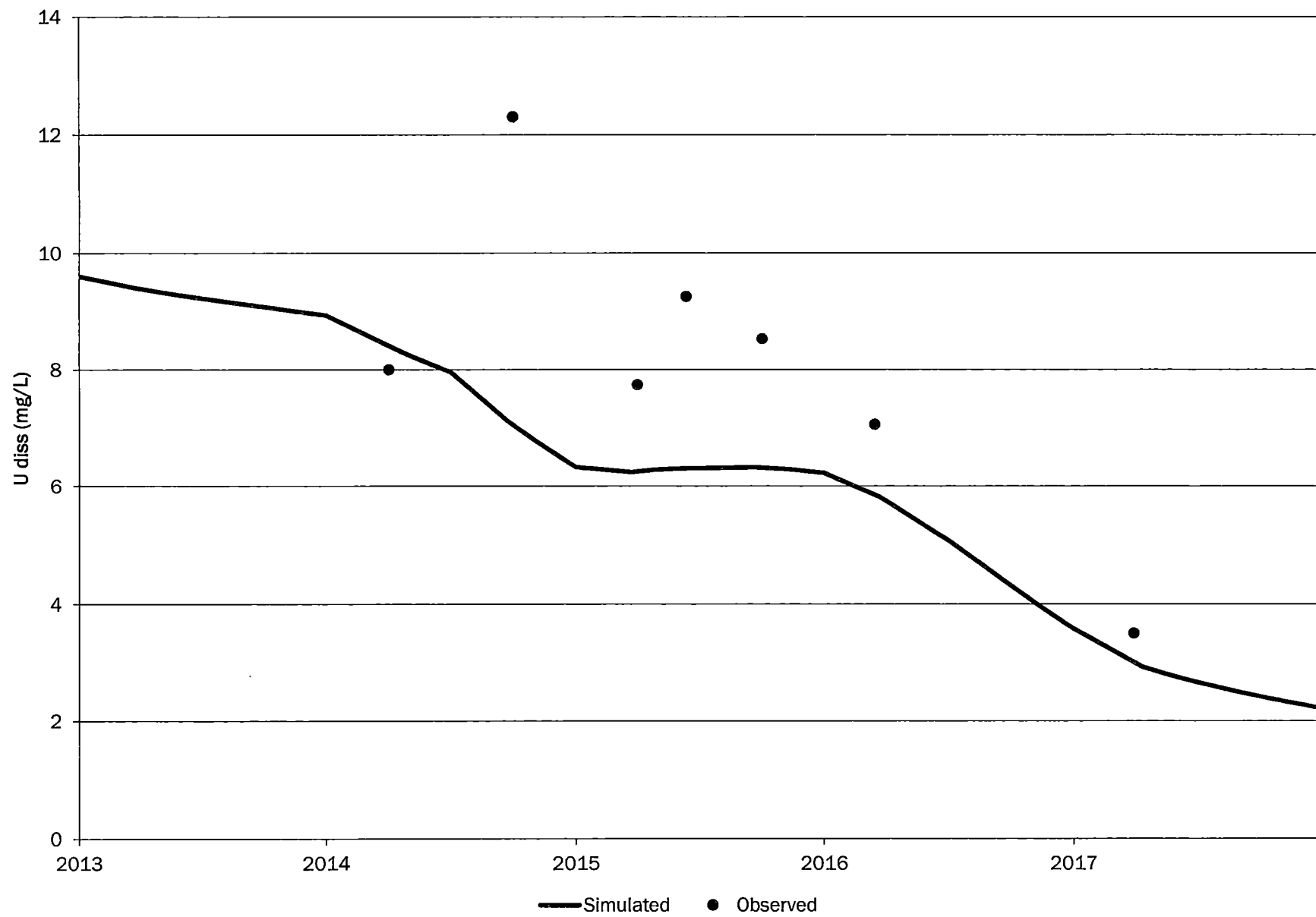
BC-AI



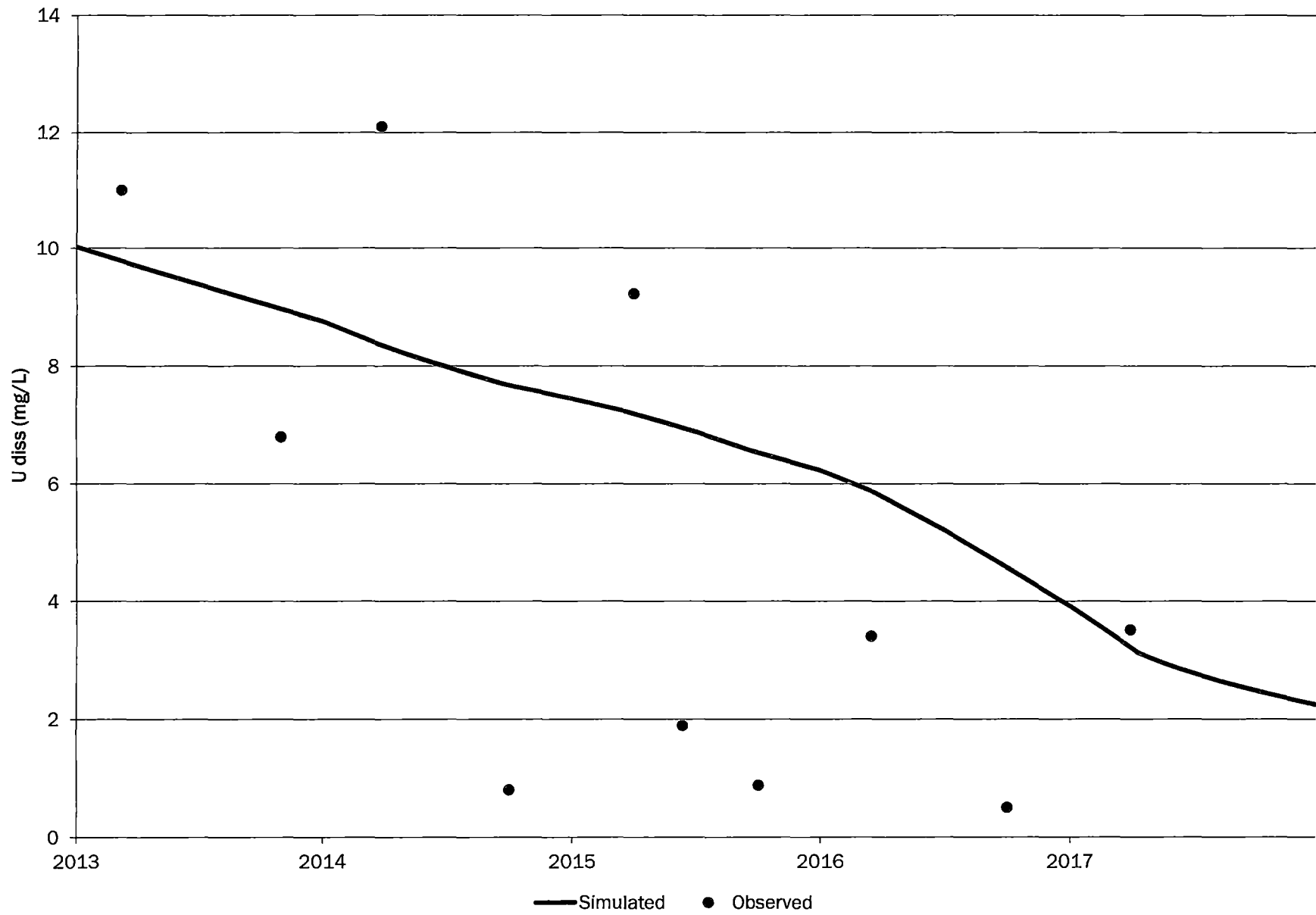
C6-AI



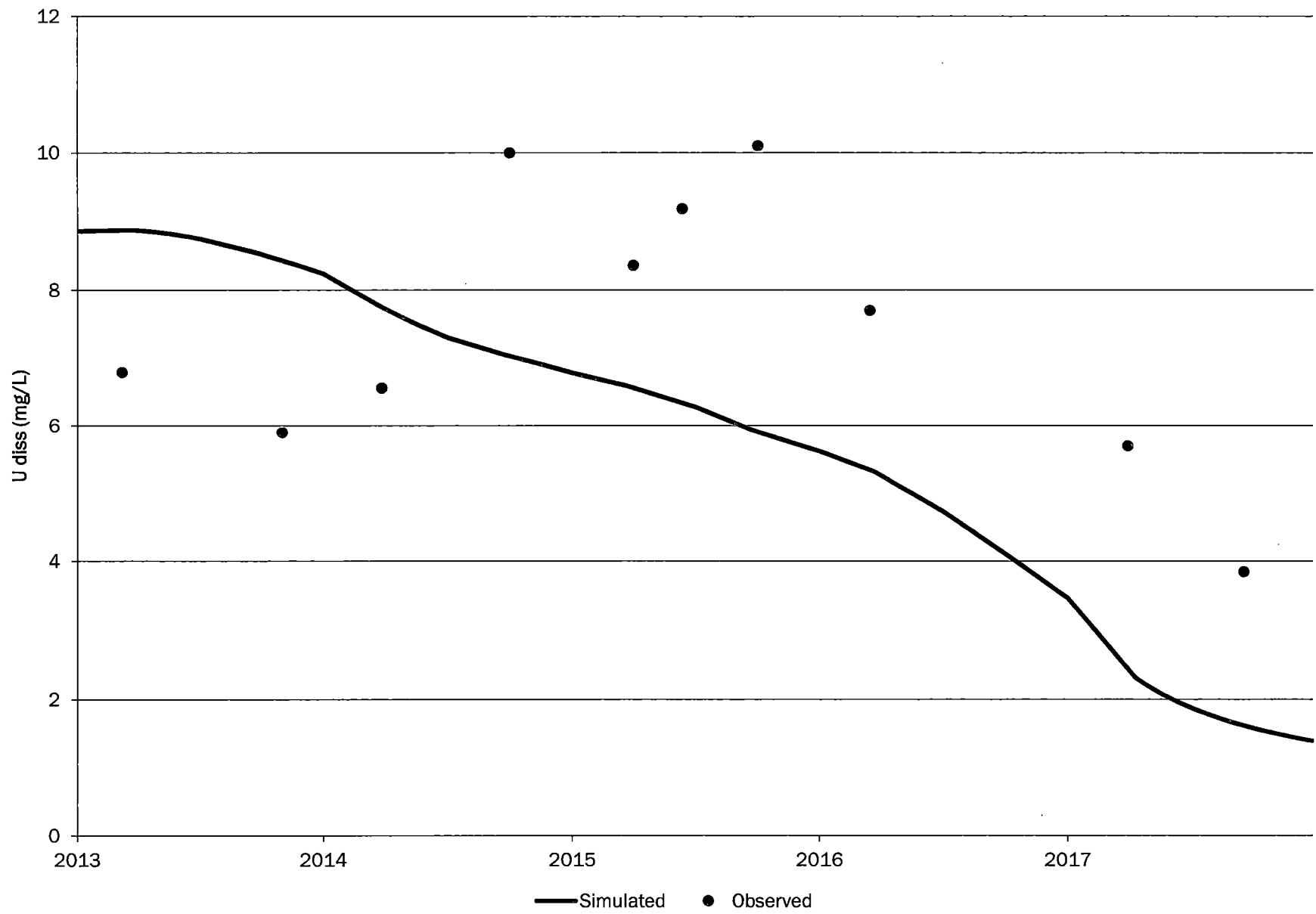
C7-AI



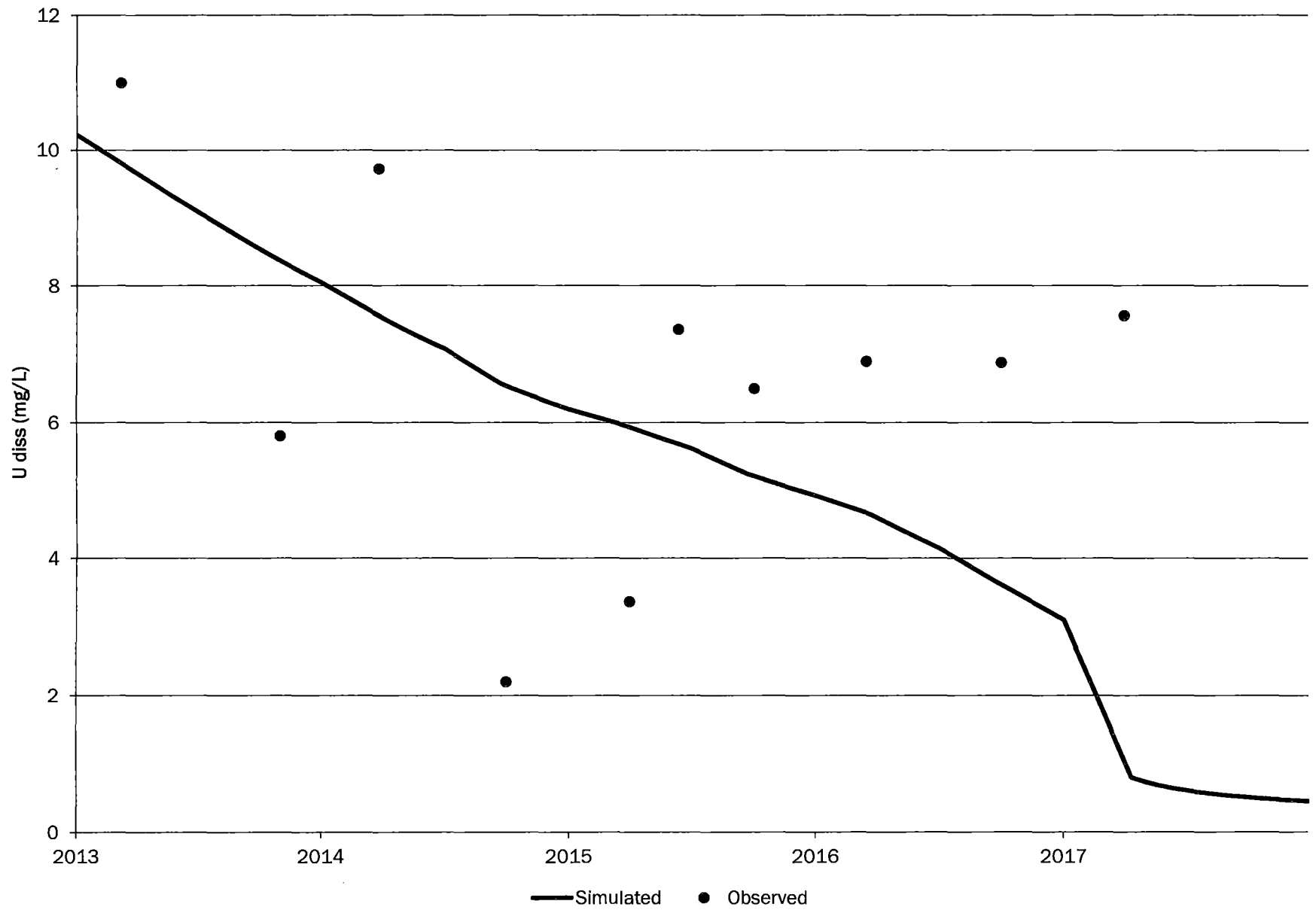
C8-AI



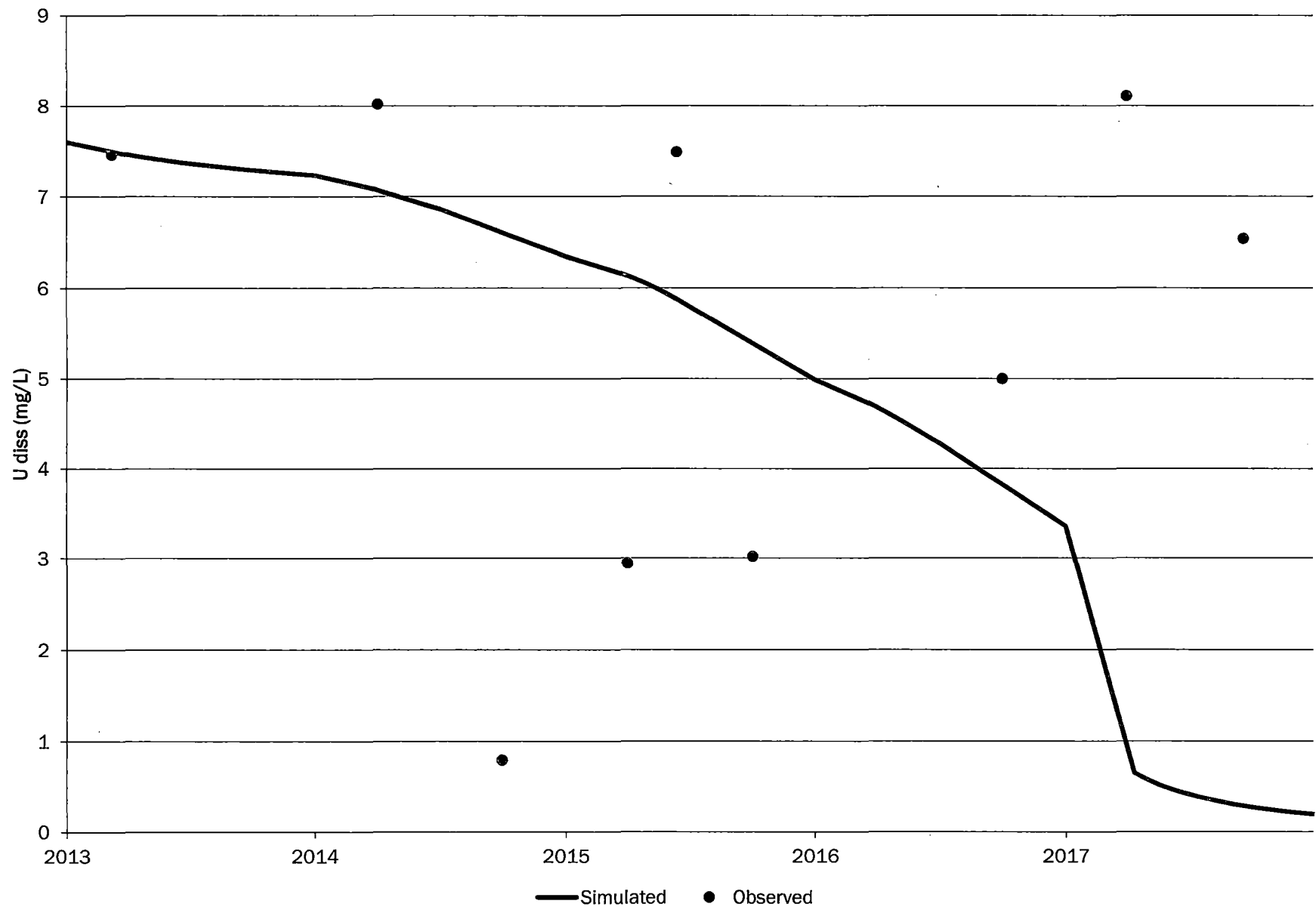
C9-AI



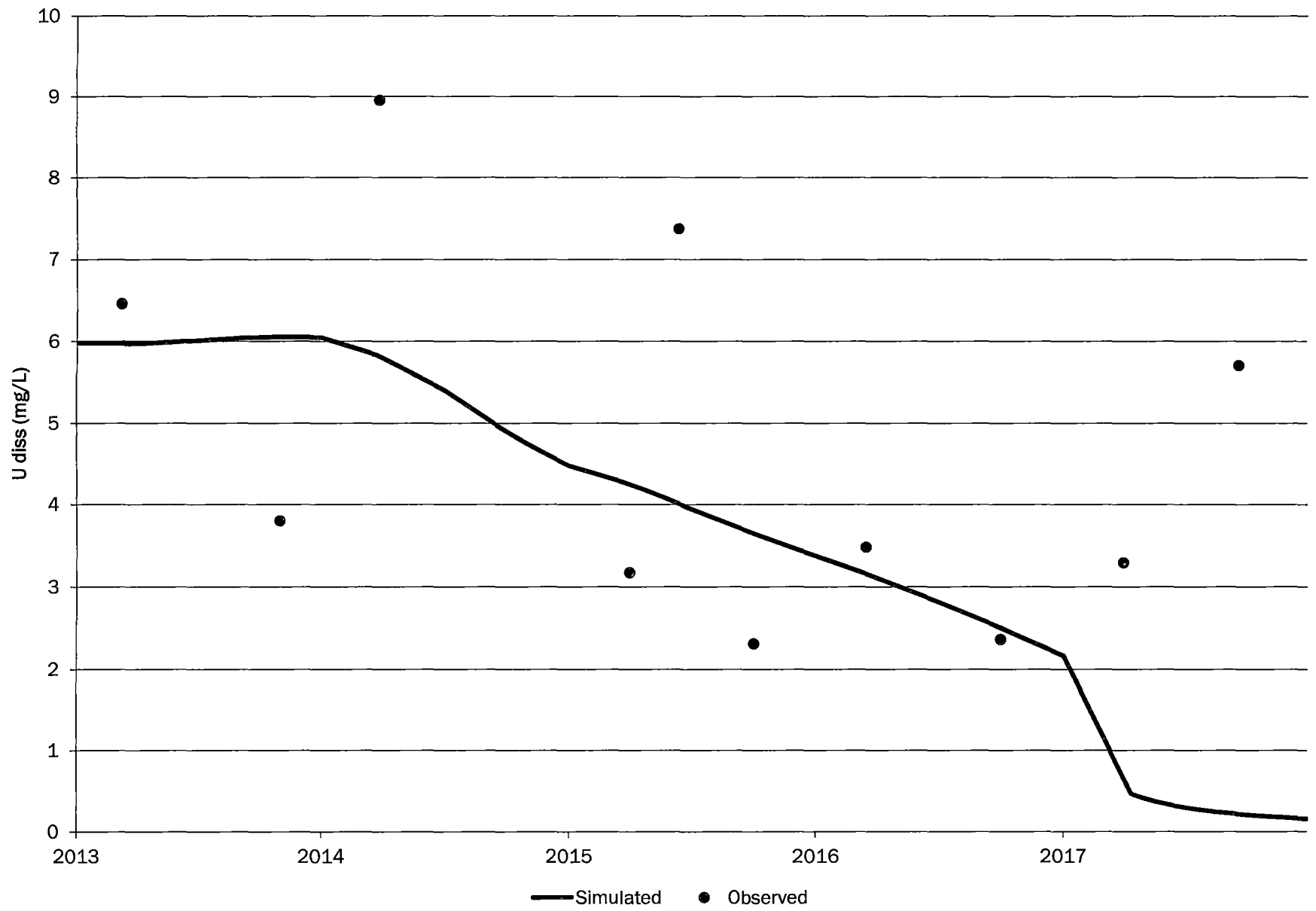
C10-AI



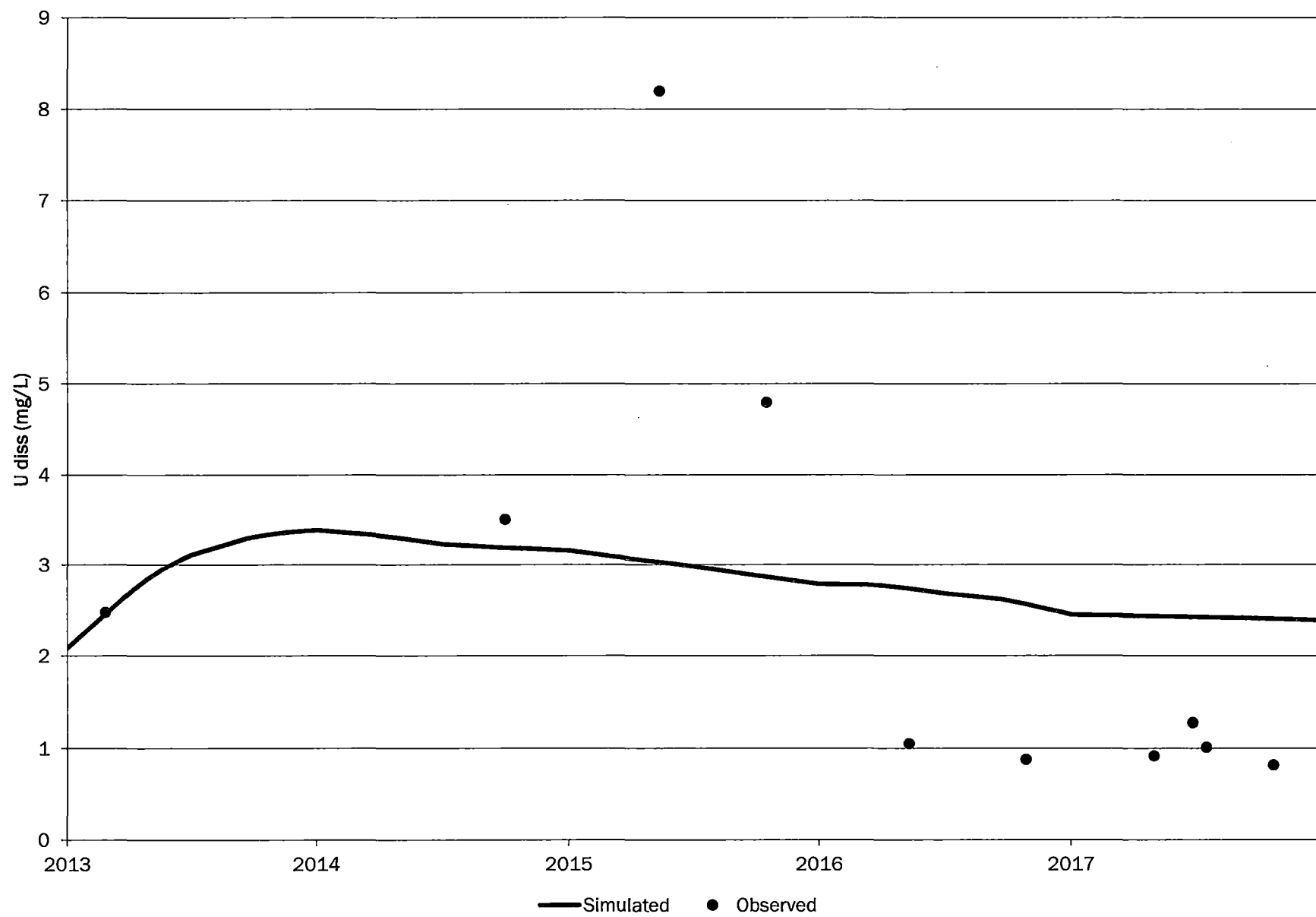
C11-AI



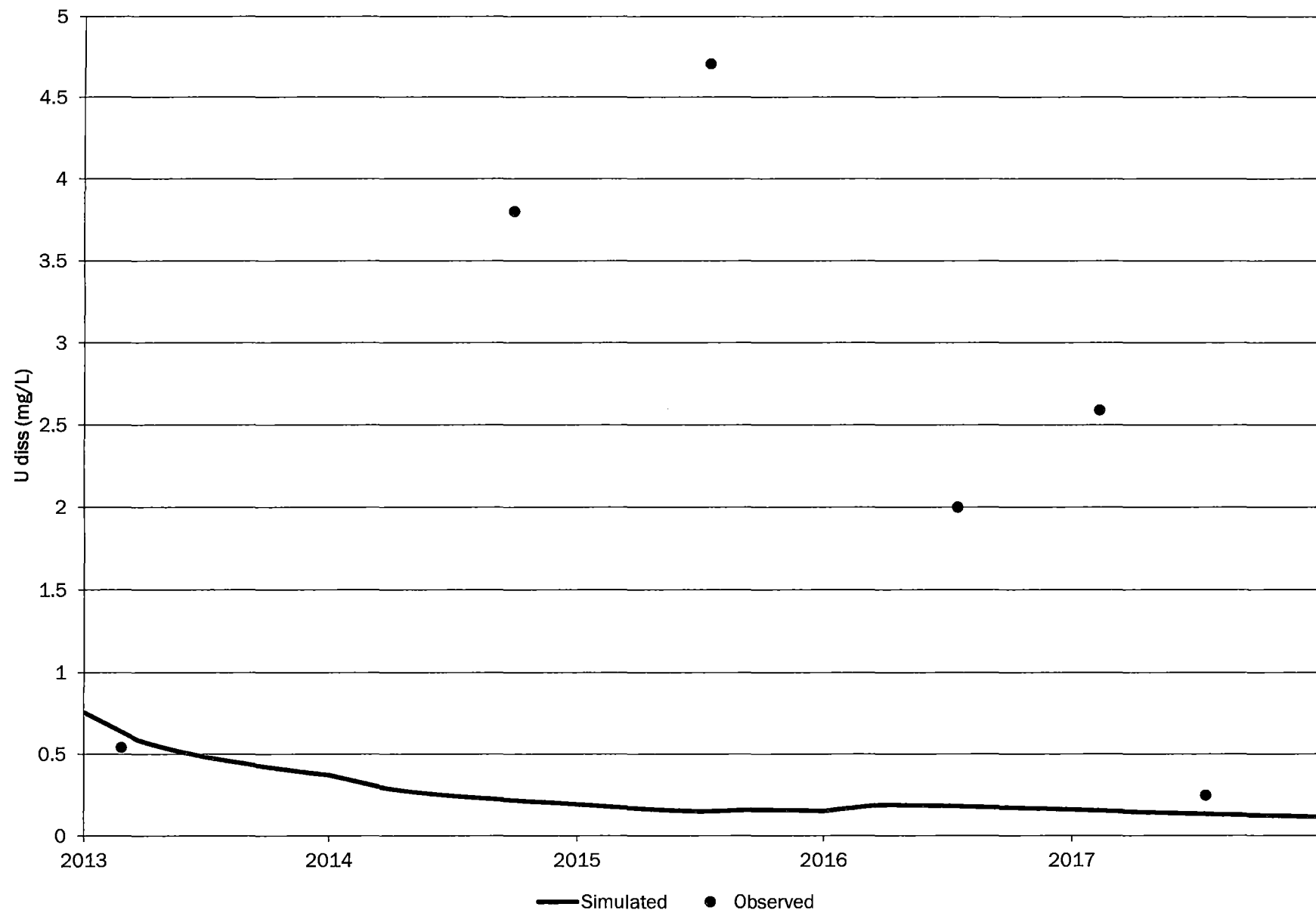
C12-AI



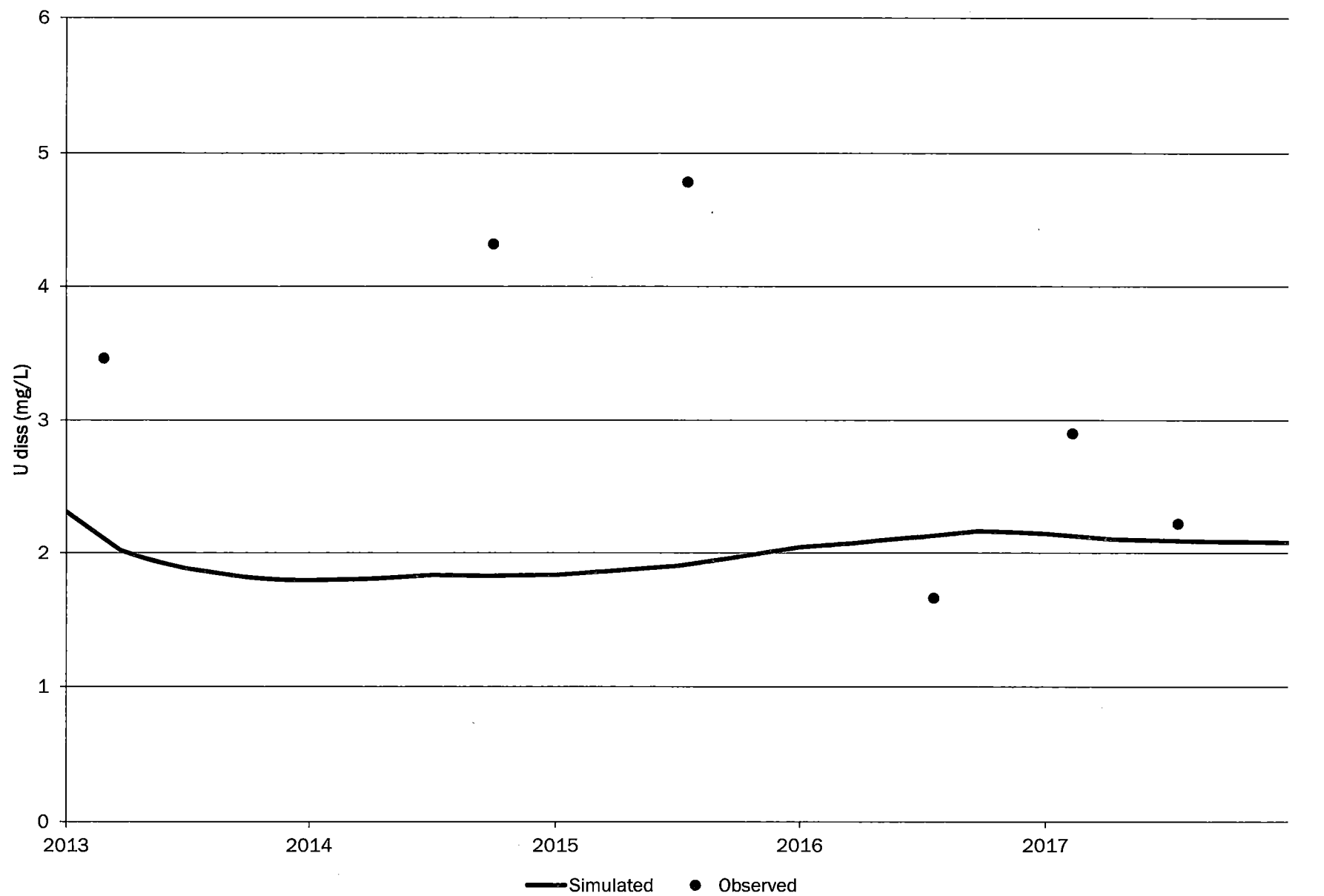
CE2-UC



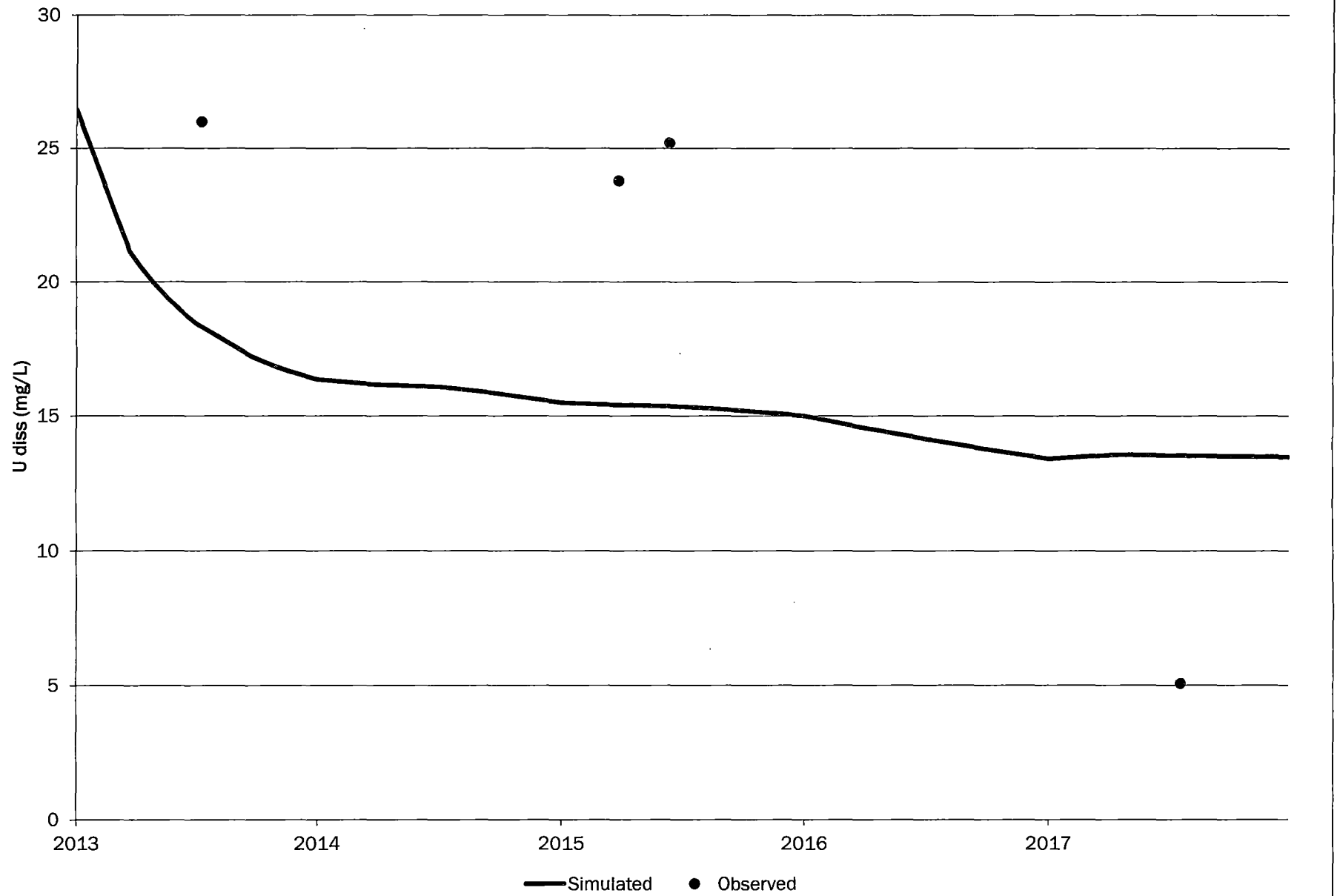
CE5-UC



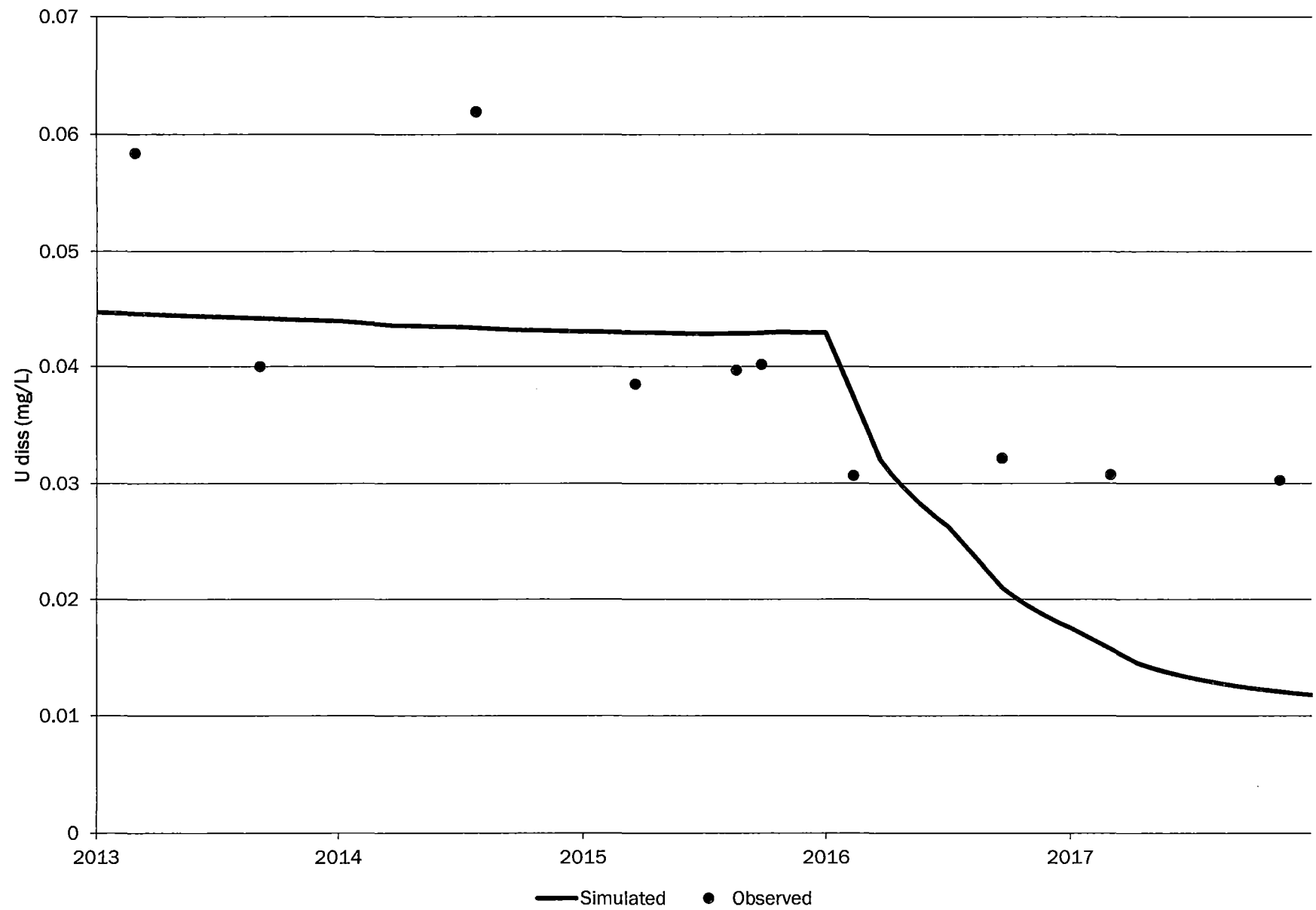
CE6-UC



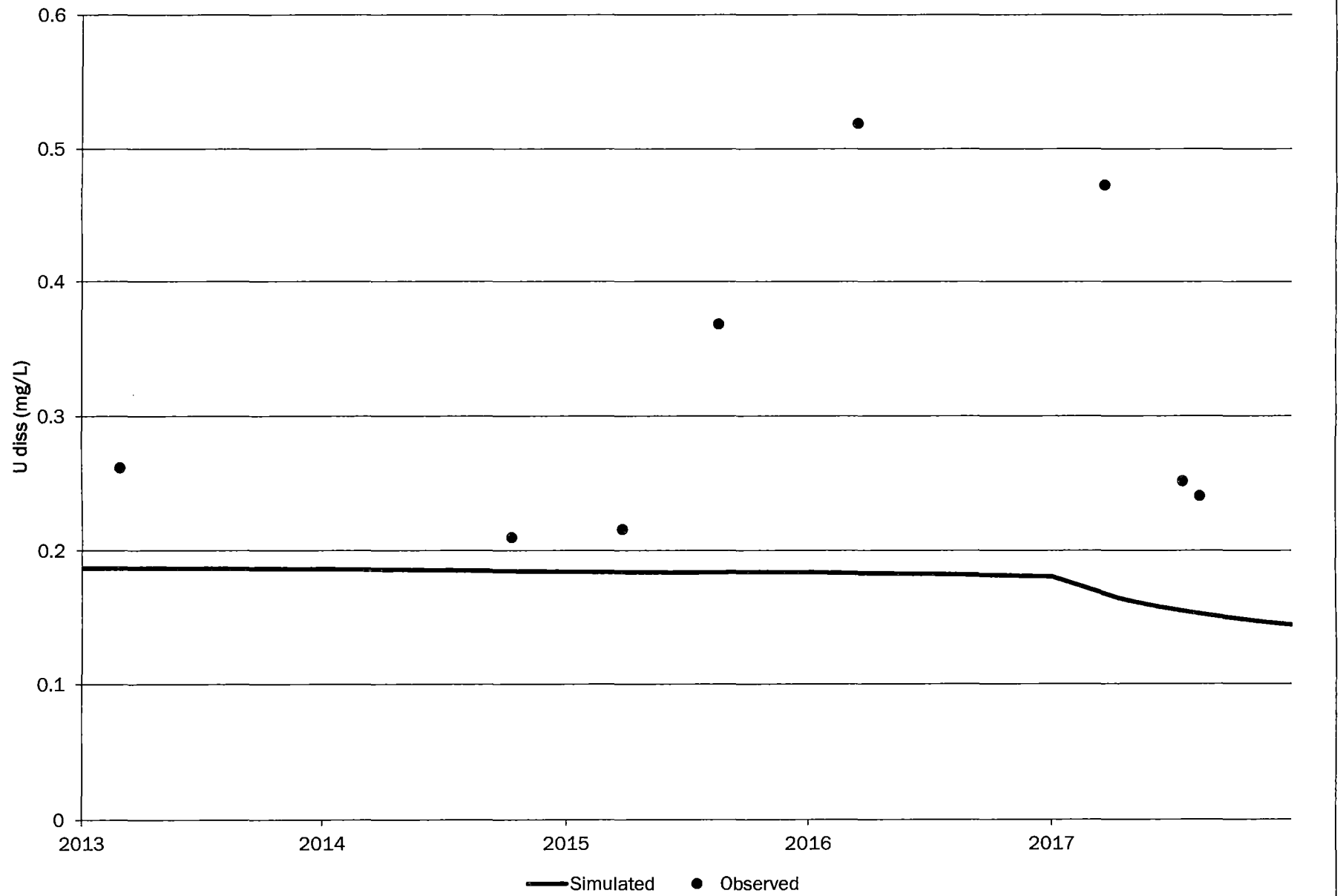
CE7-UC



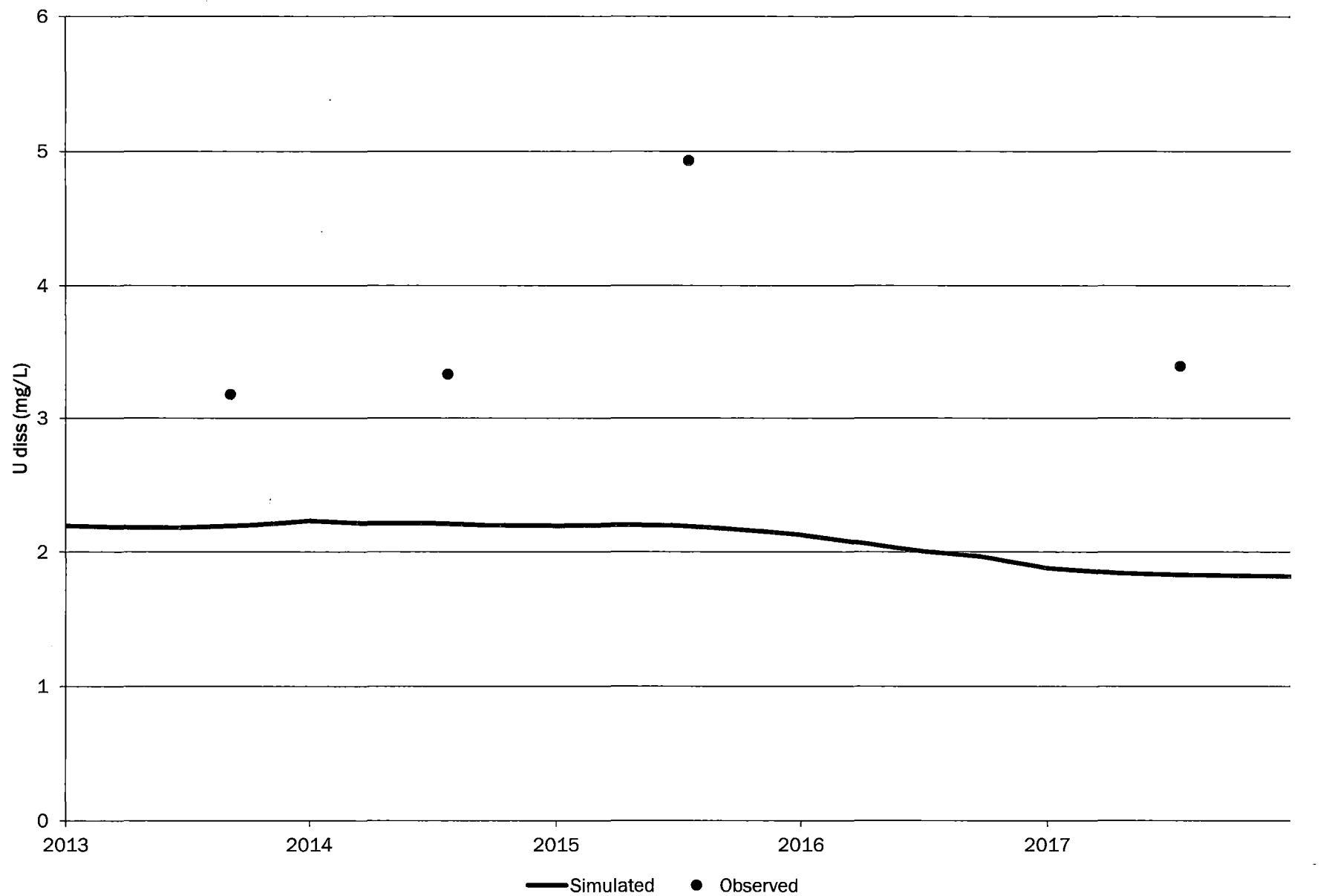
CE8-UC



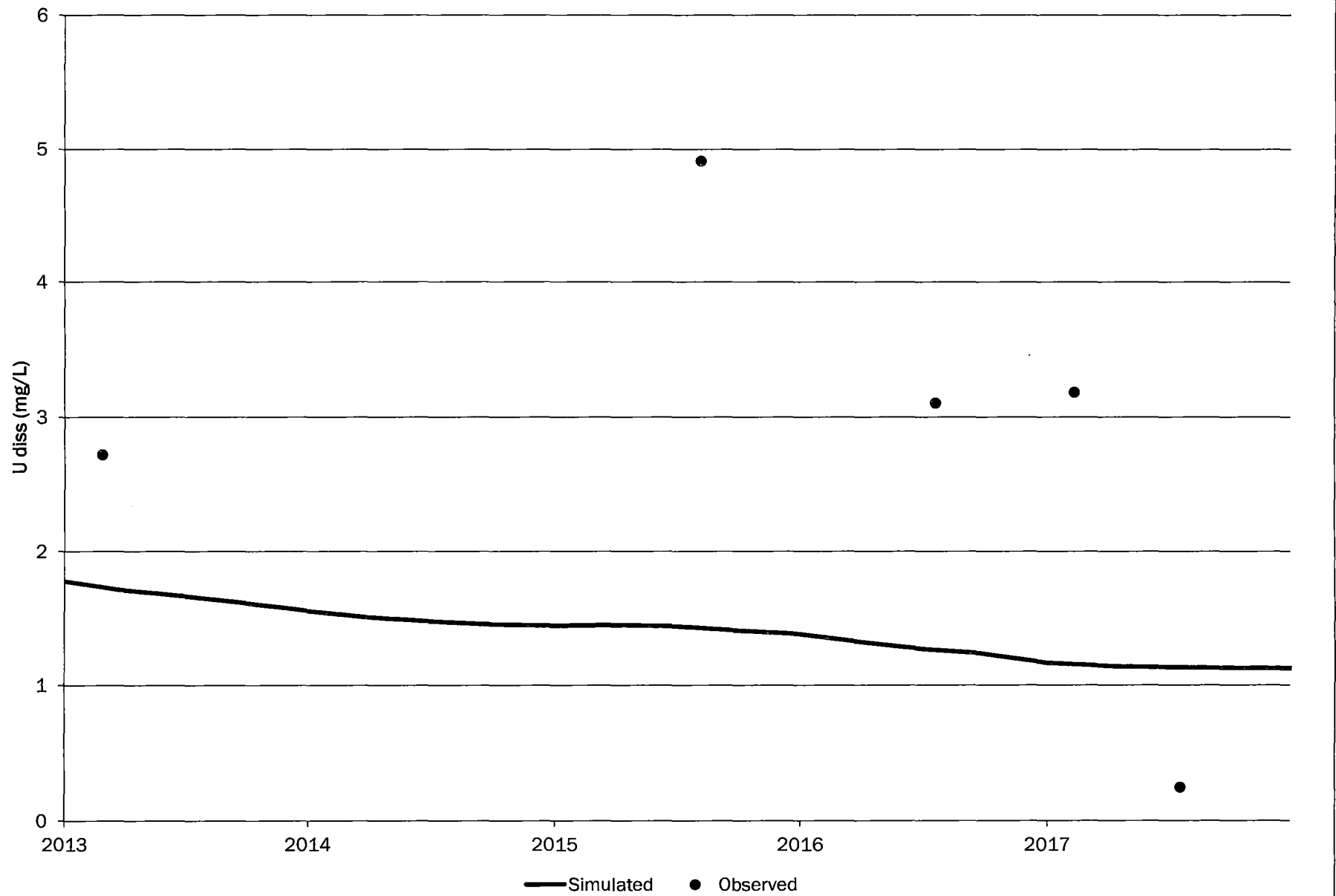
CE9-UC



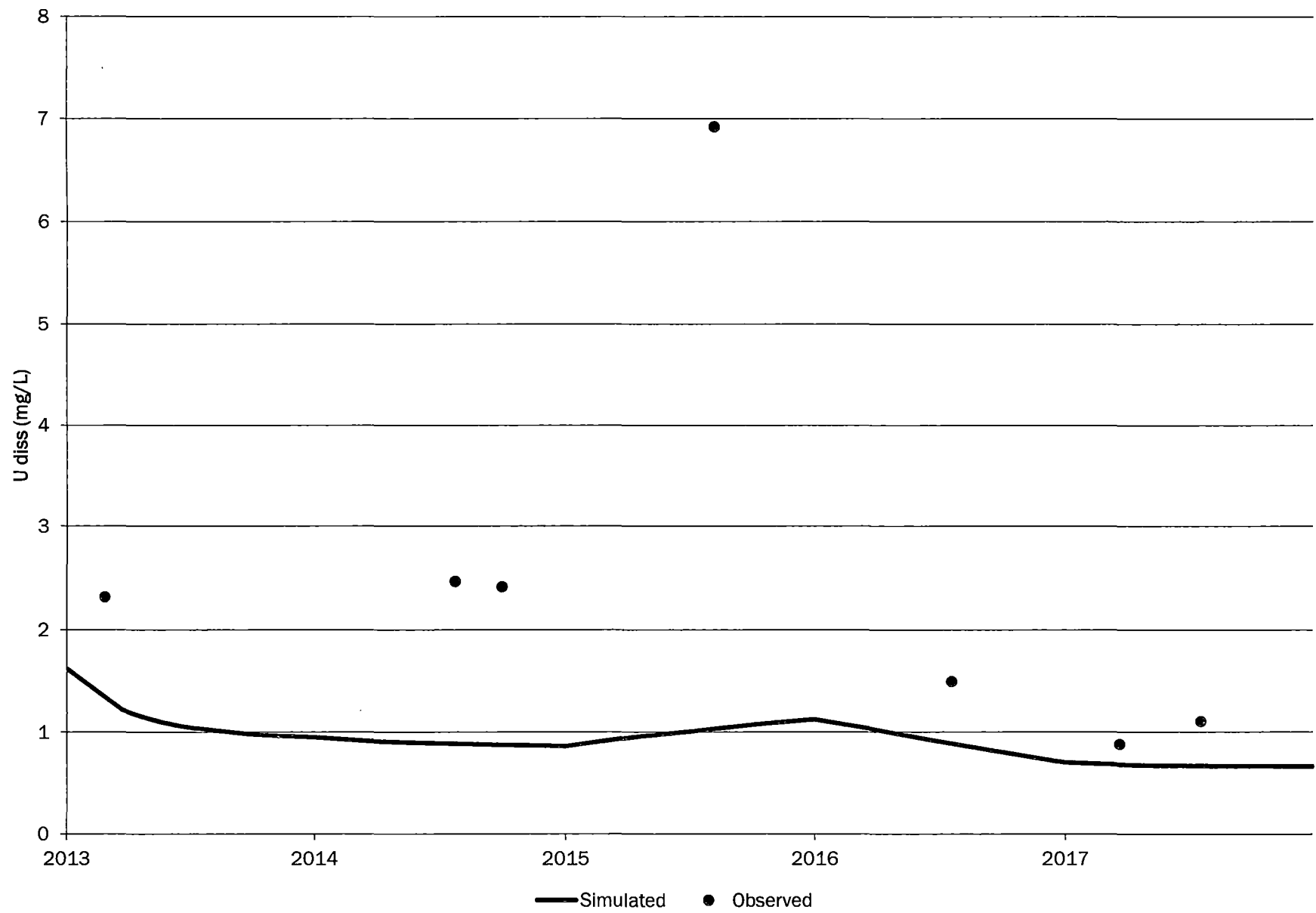
CE10-UC



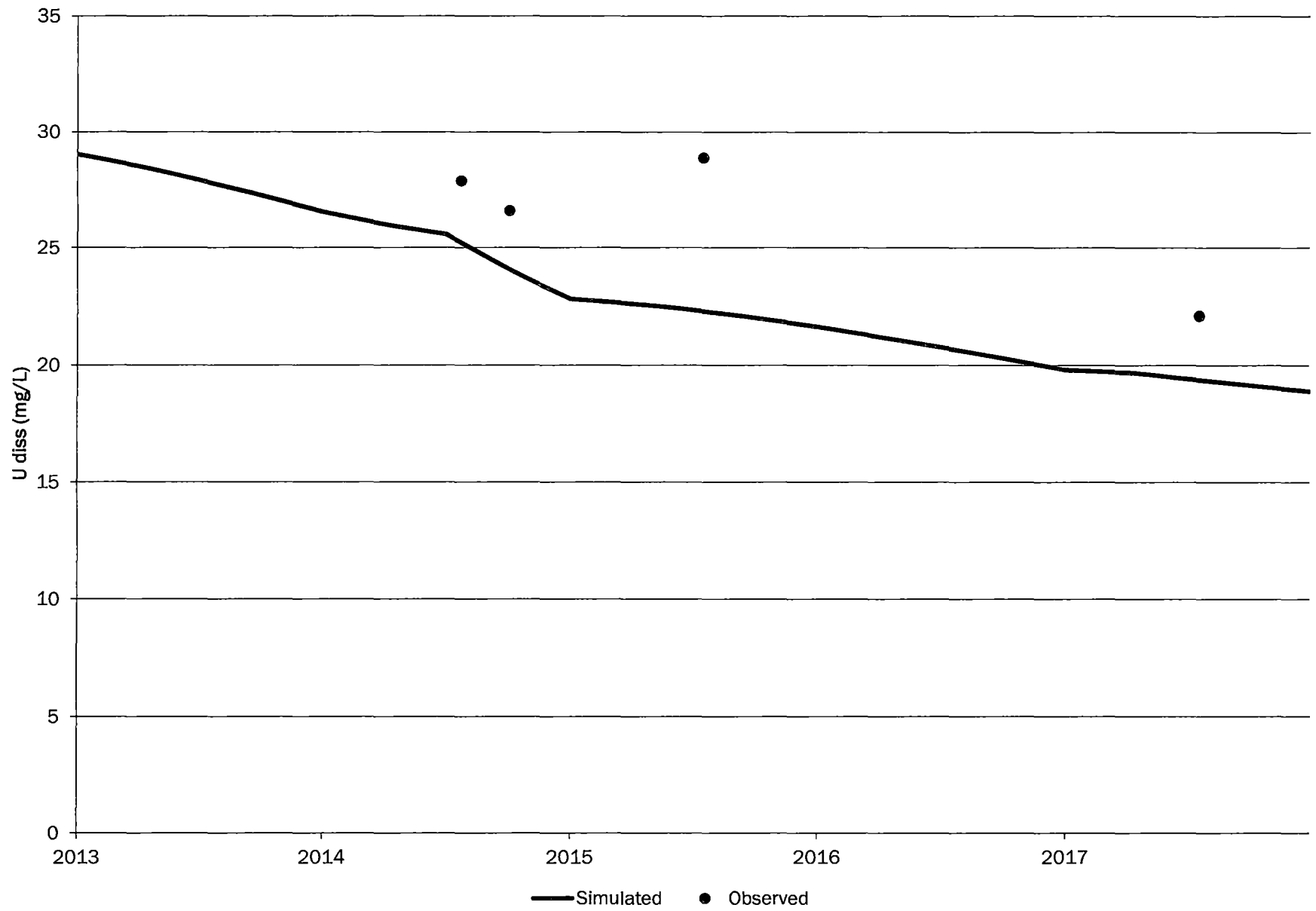
CE11-UC



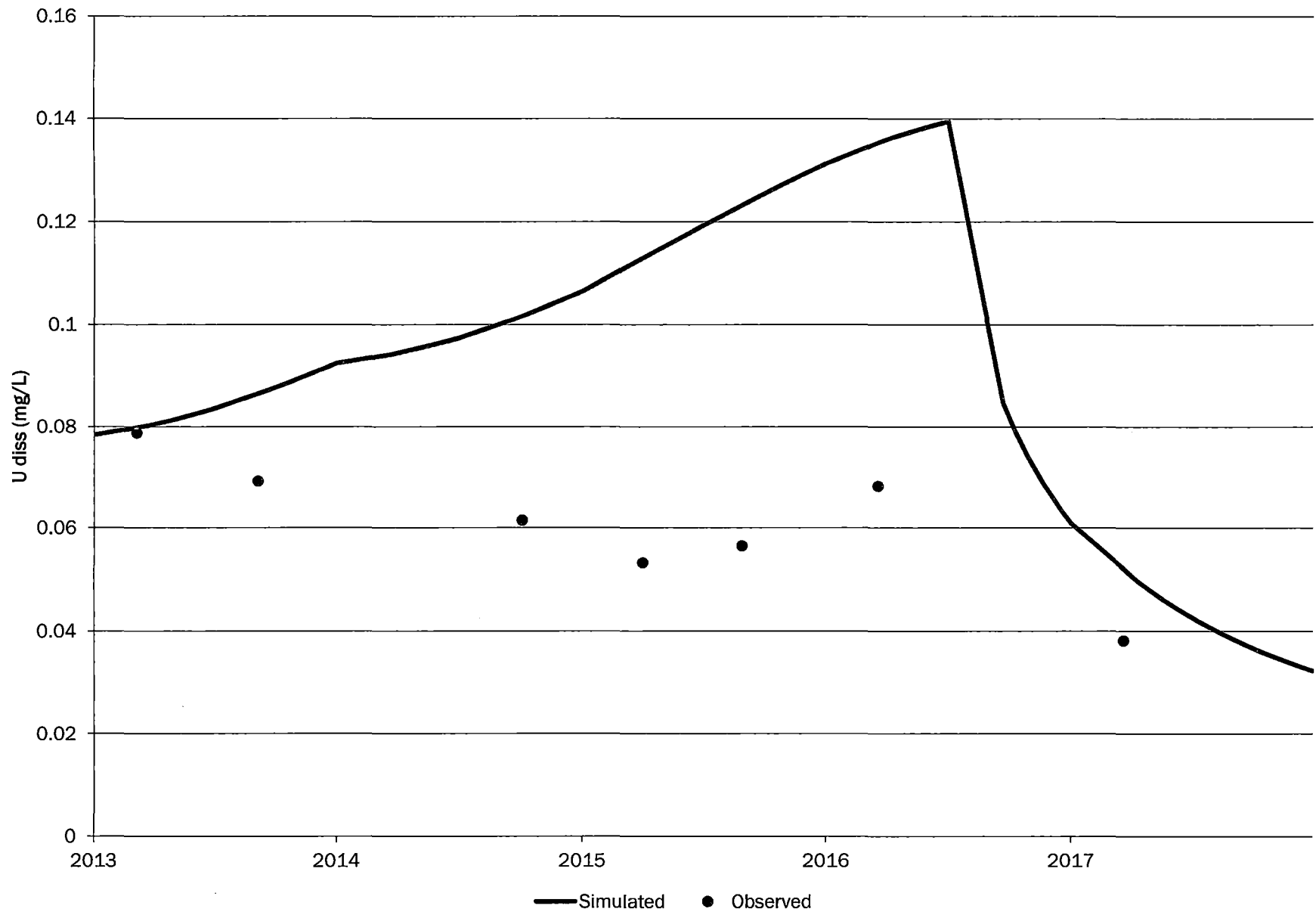
CE12-UC



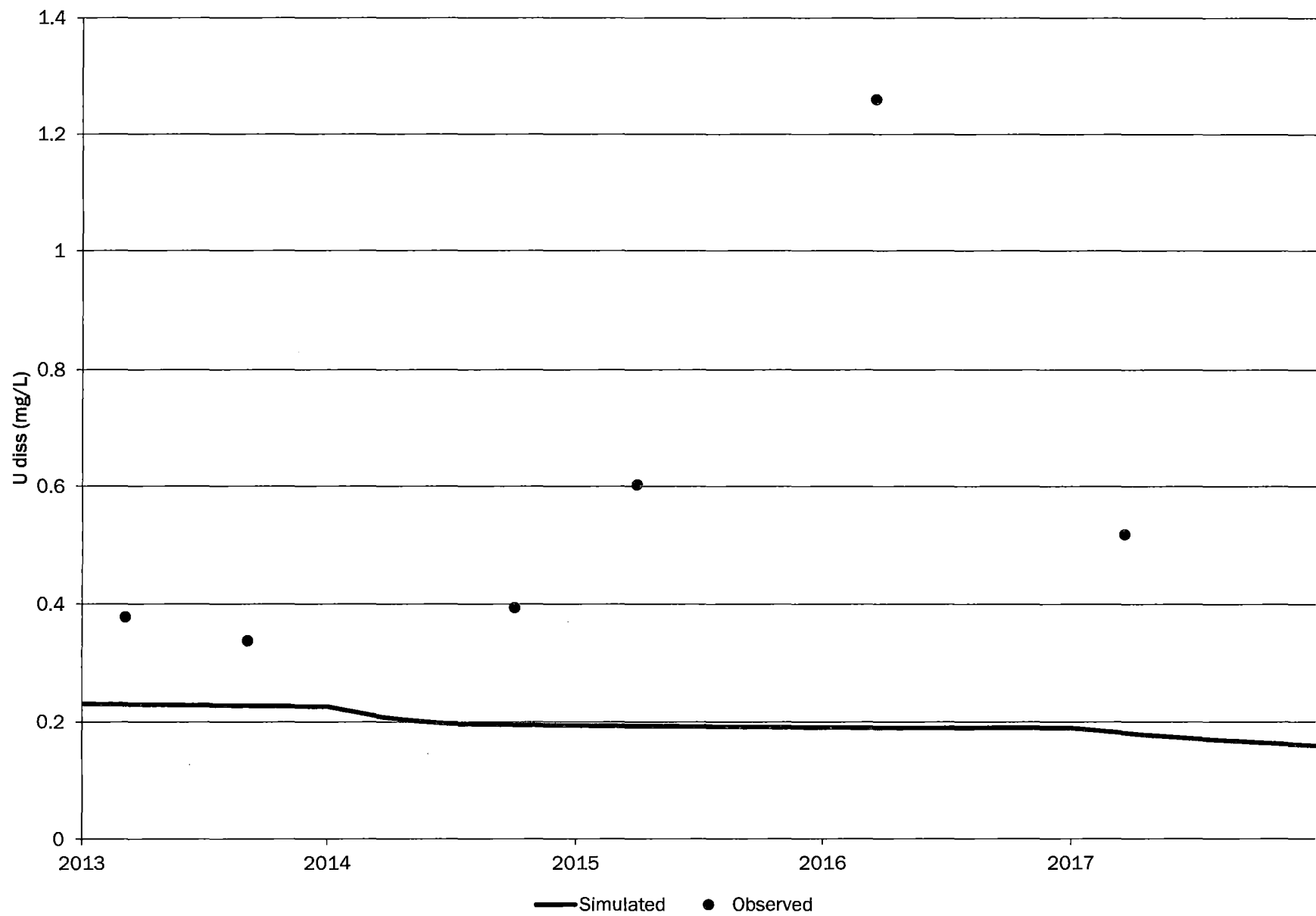
CE13-UC



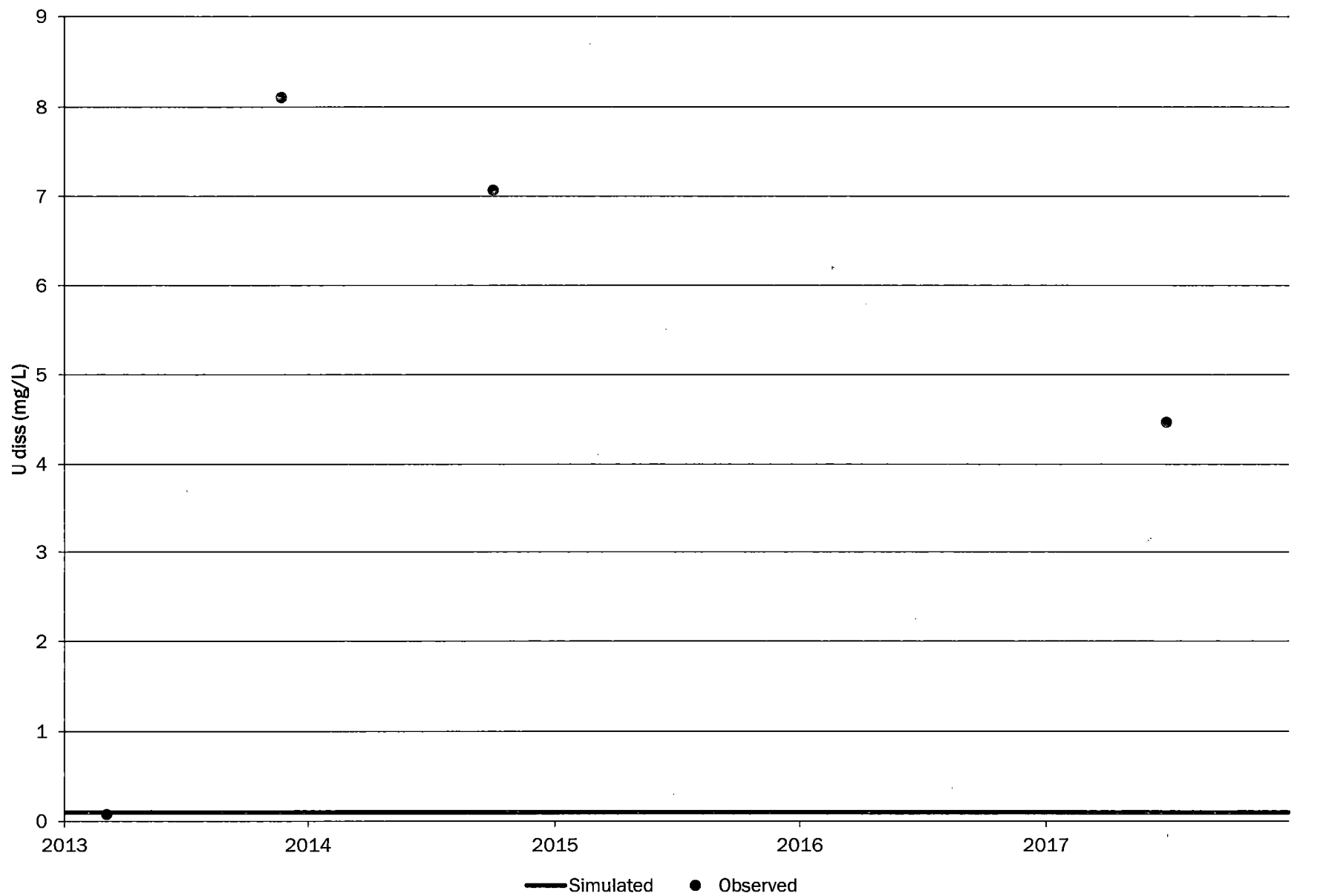
CE14-UC



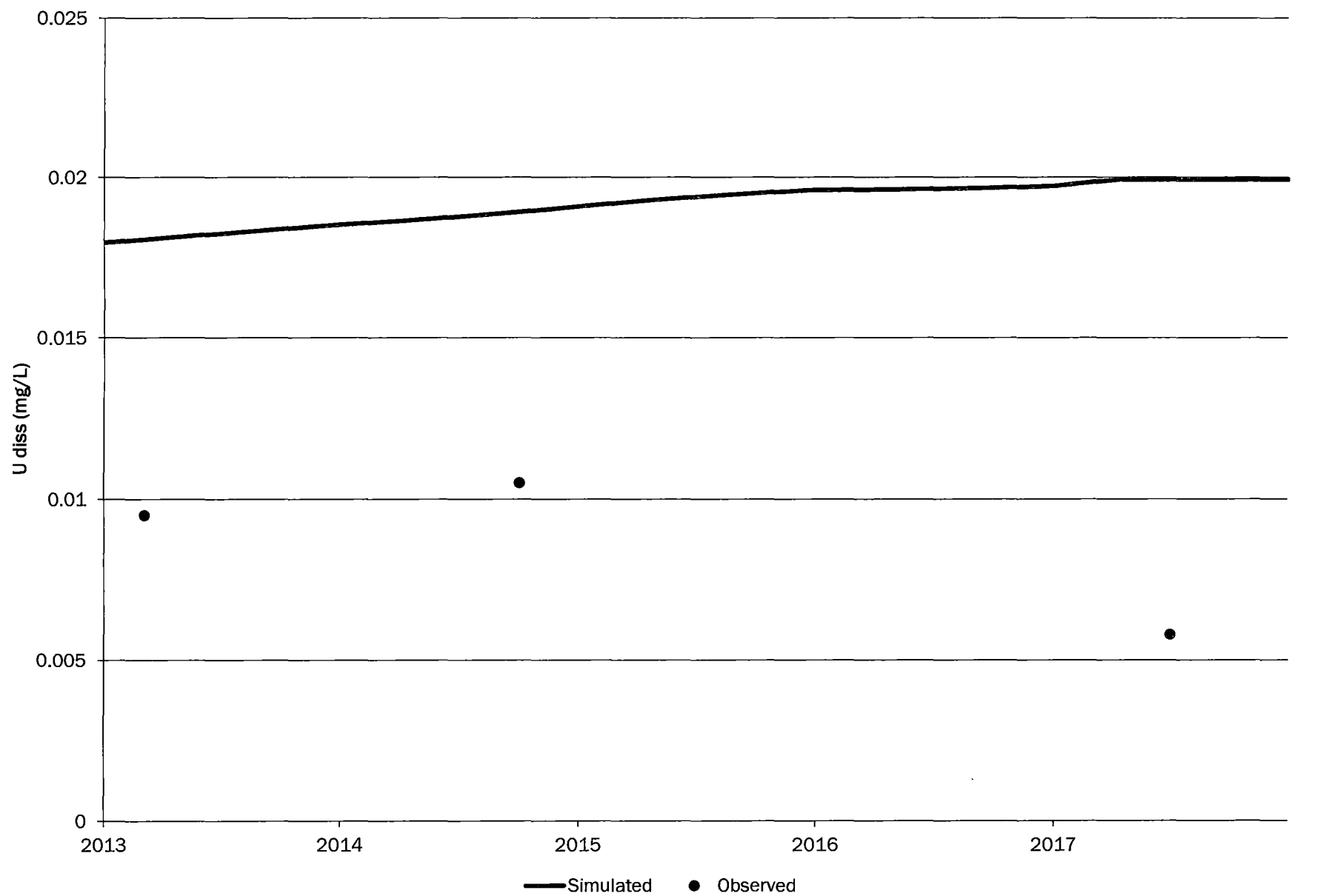
CE15-UC



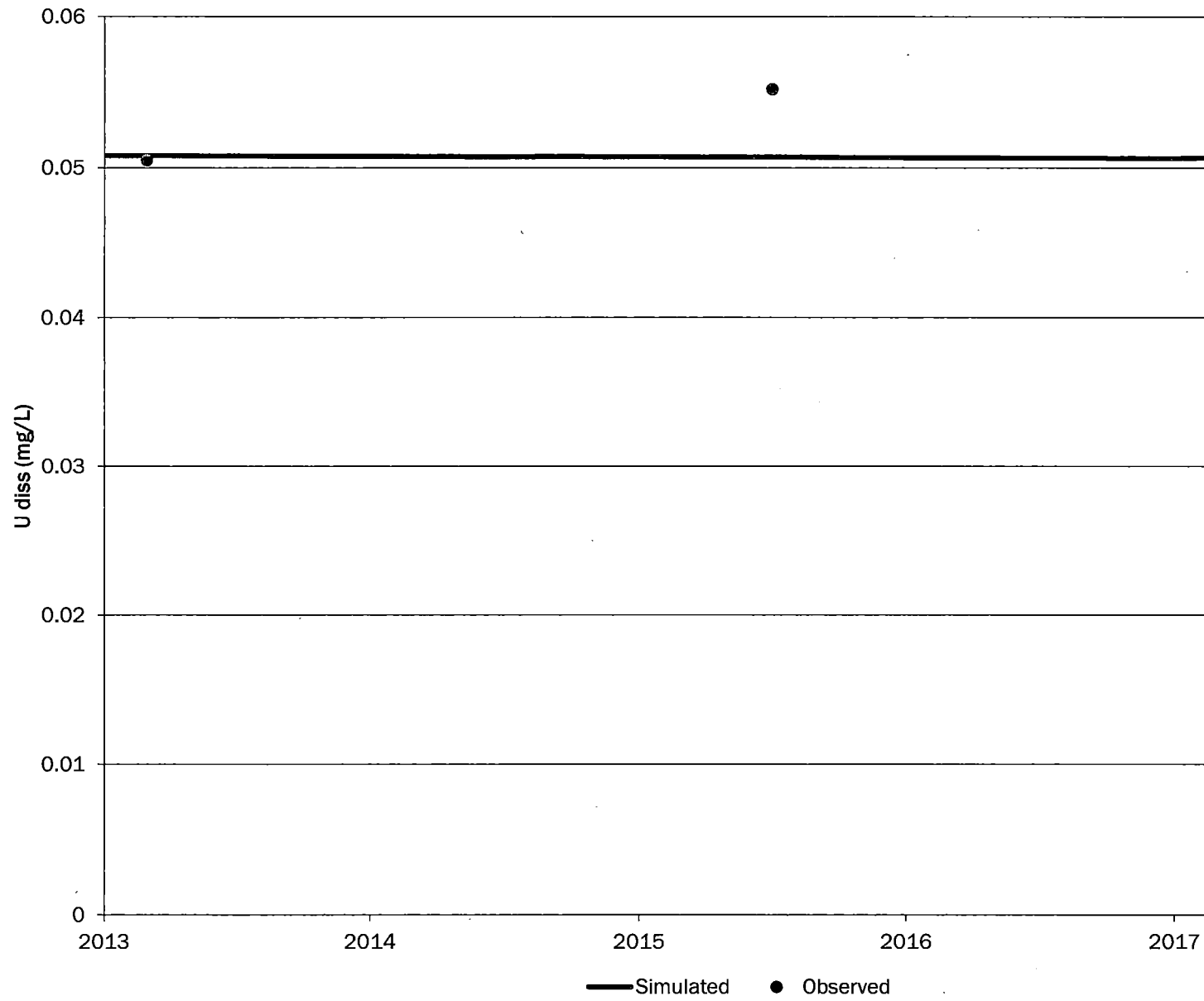
CF1-UC



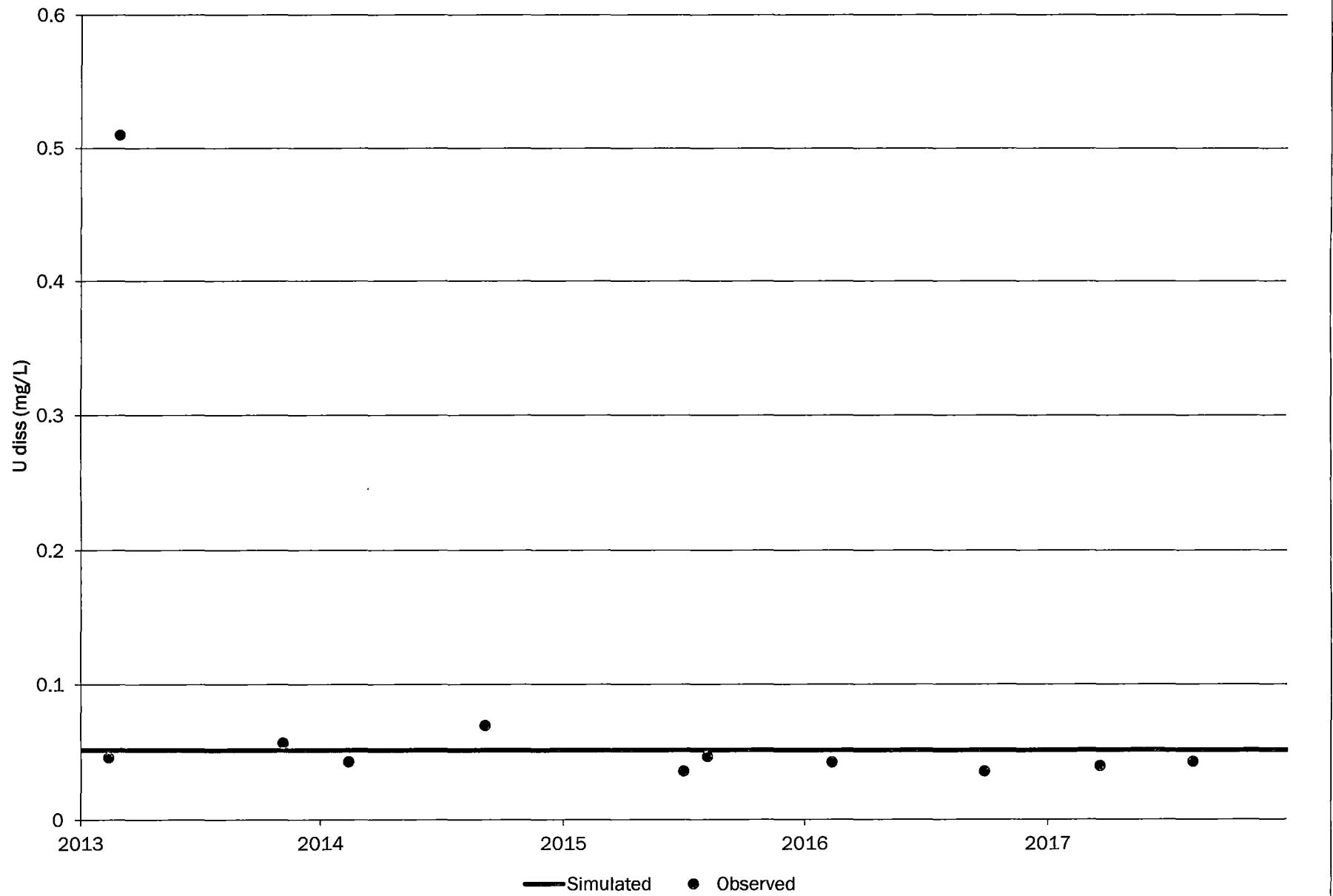
CF2-UC



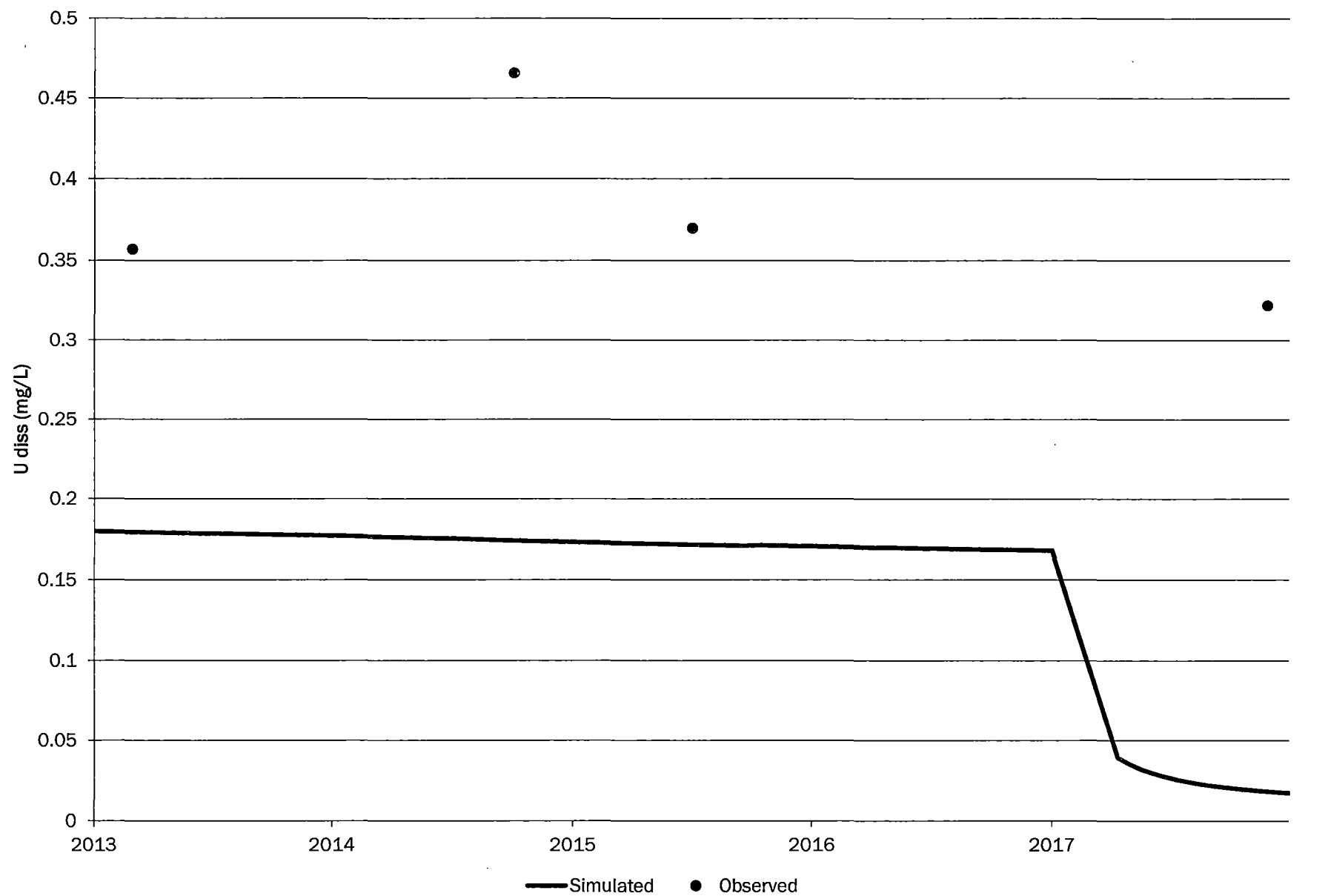
CW1-MC



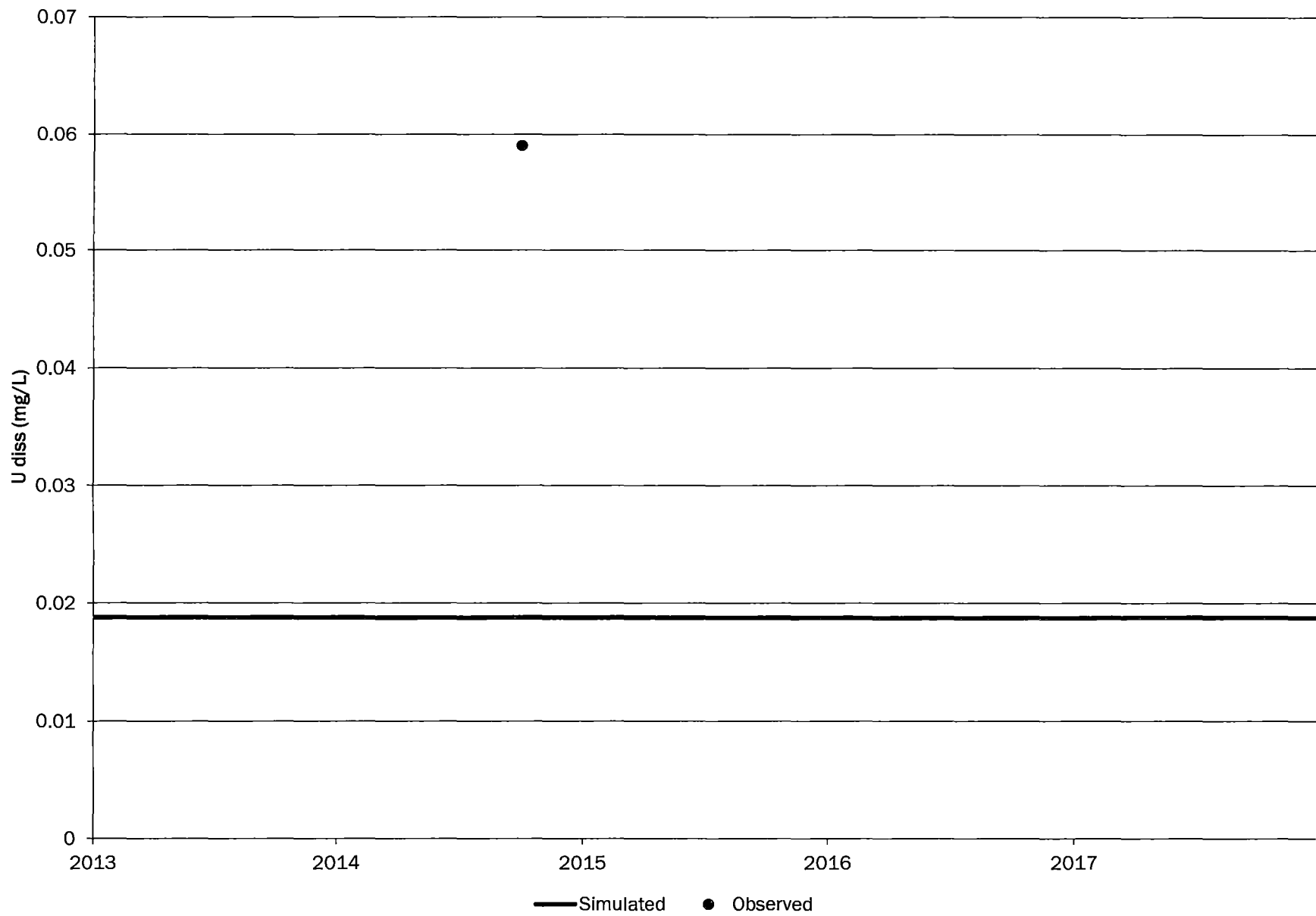
CW2-MC



CW3-UC



CW6-MC



CW9-UC

U diss (mg/L)

0.06
0.05
0.04
0.03
0.02
0.01
0

2013

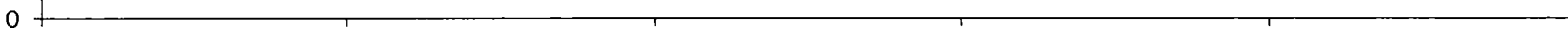
2014

2015

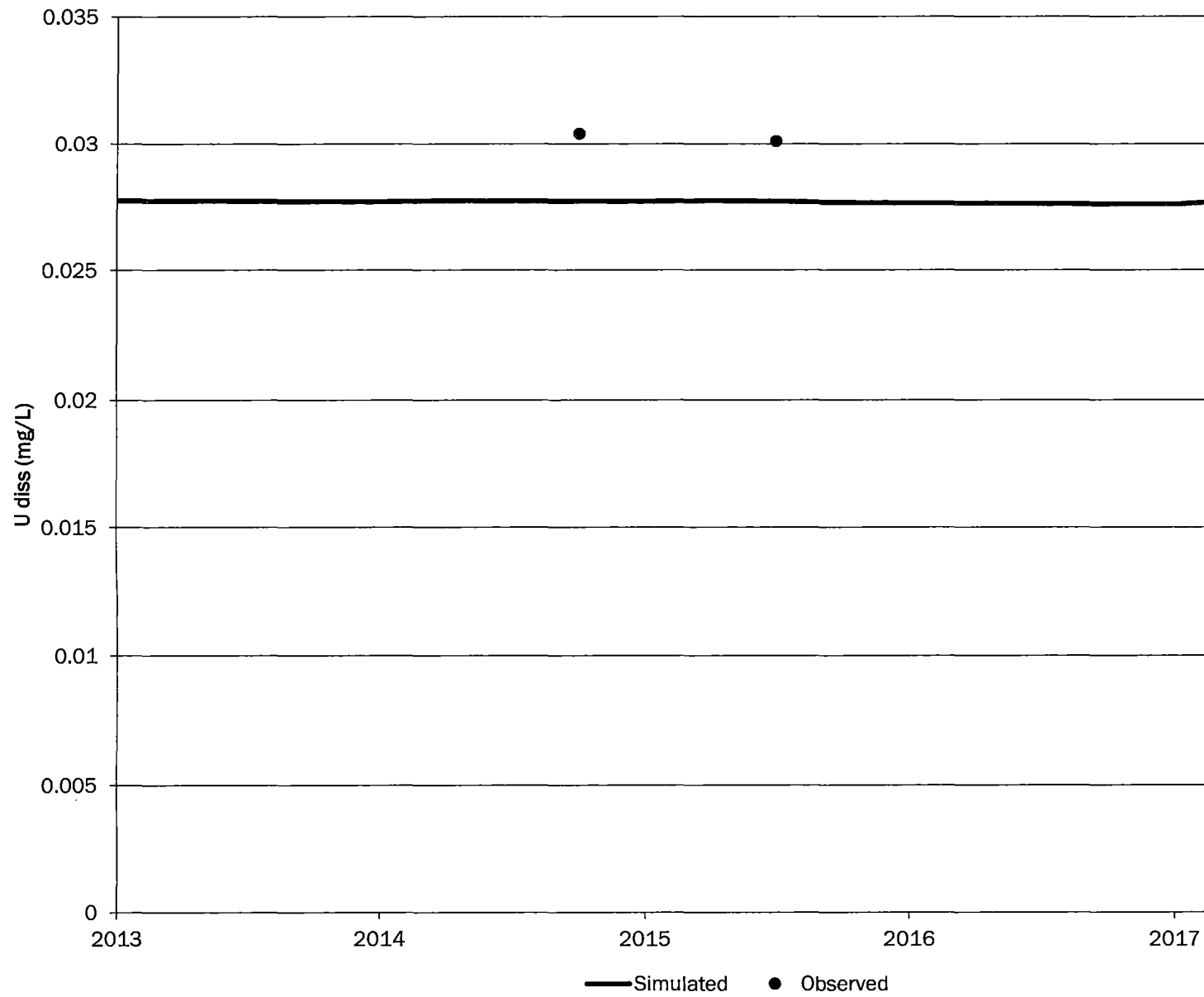
2016

2017

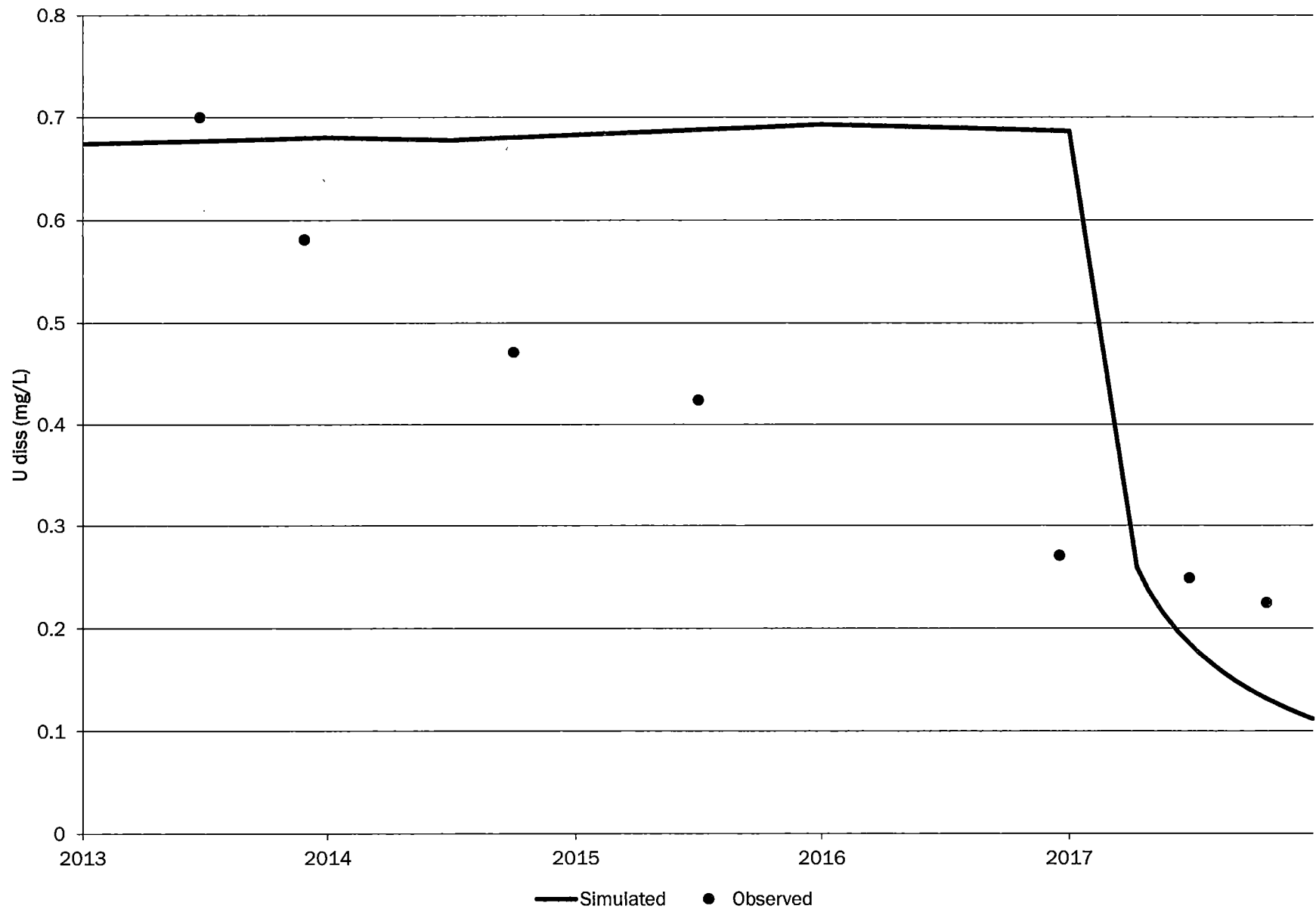
— Simulated • Observed



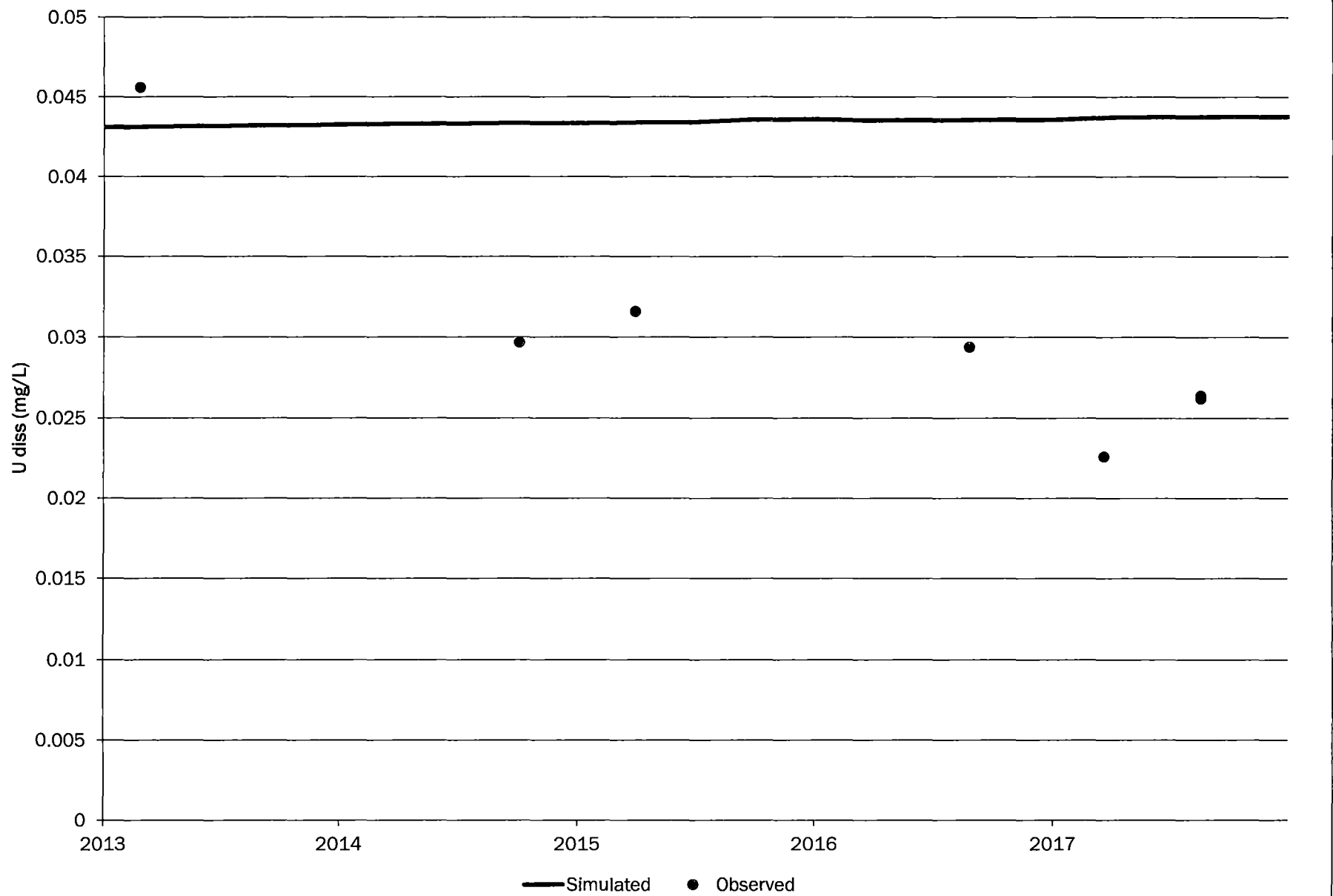
CW15-MC



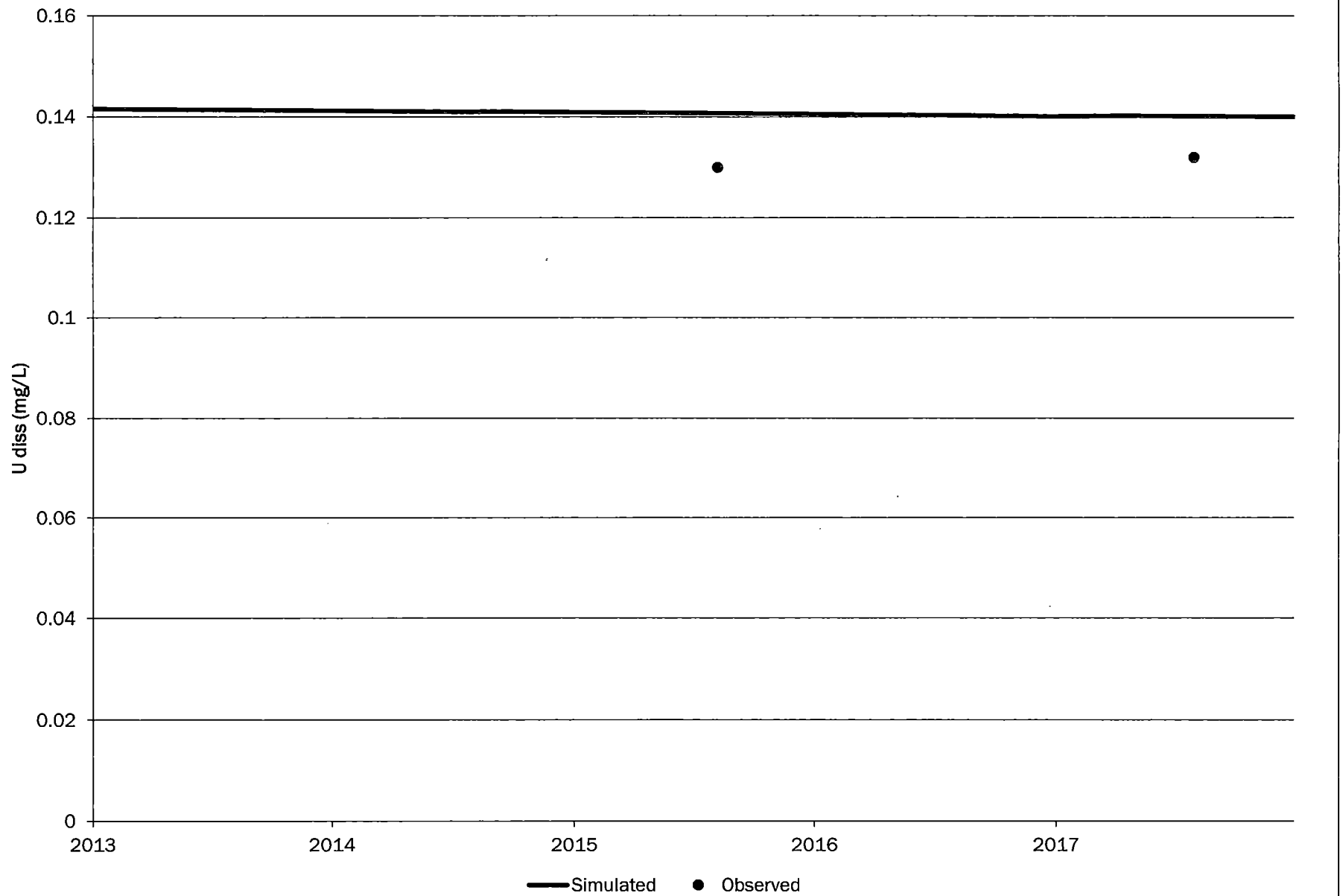
CW17-MC



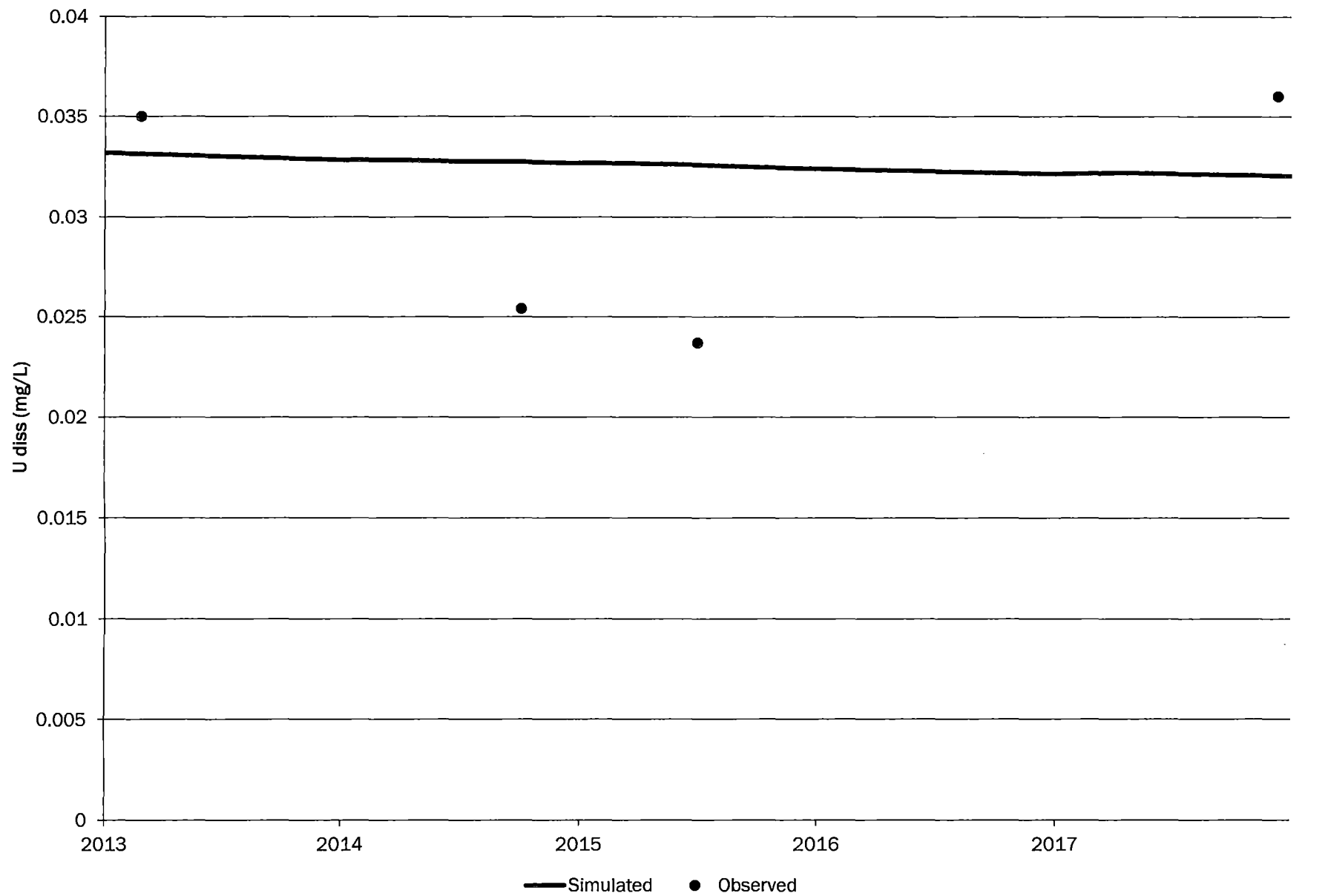
CW18-UC



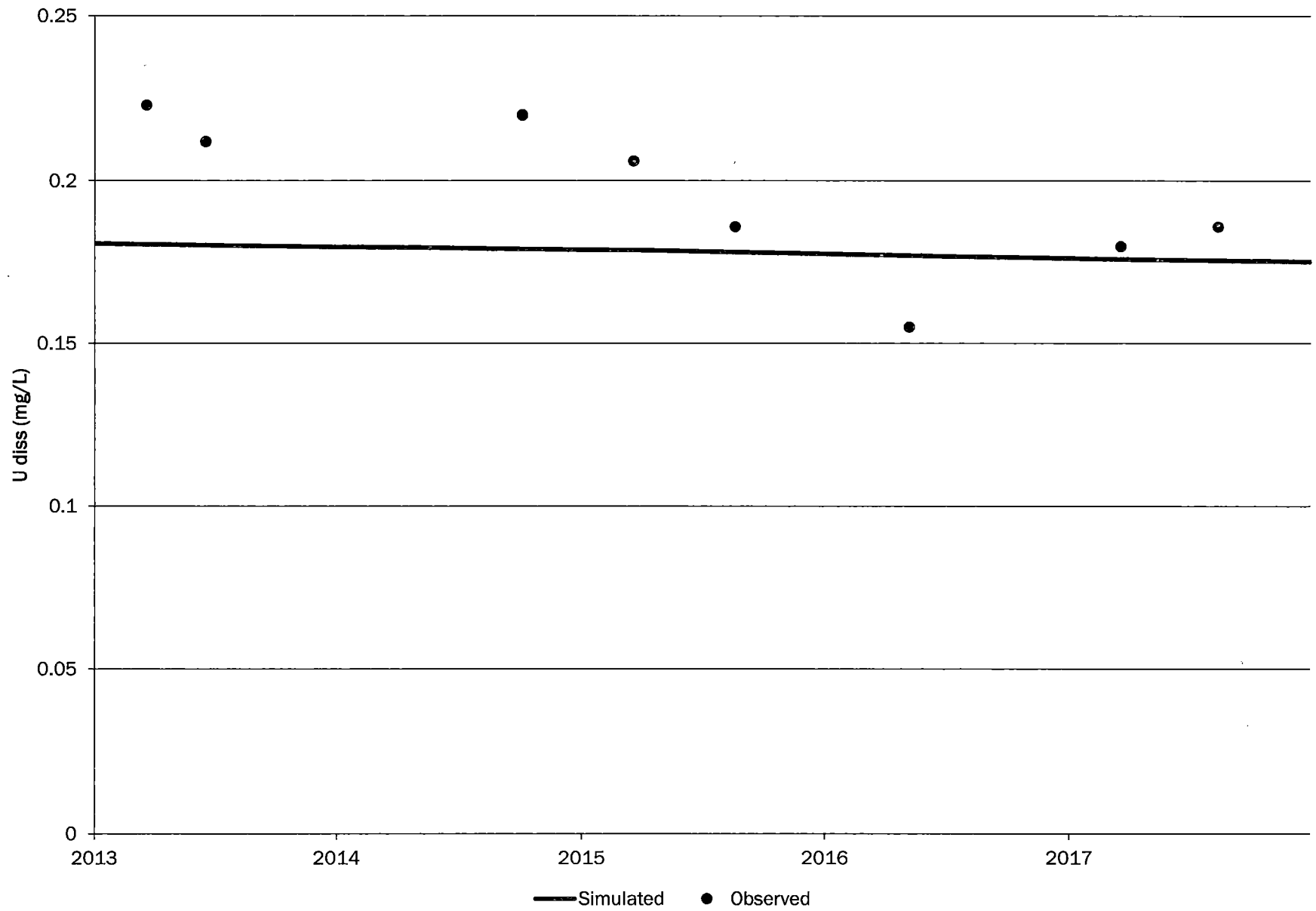
CW24-MC



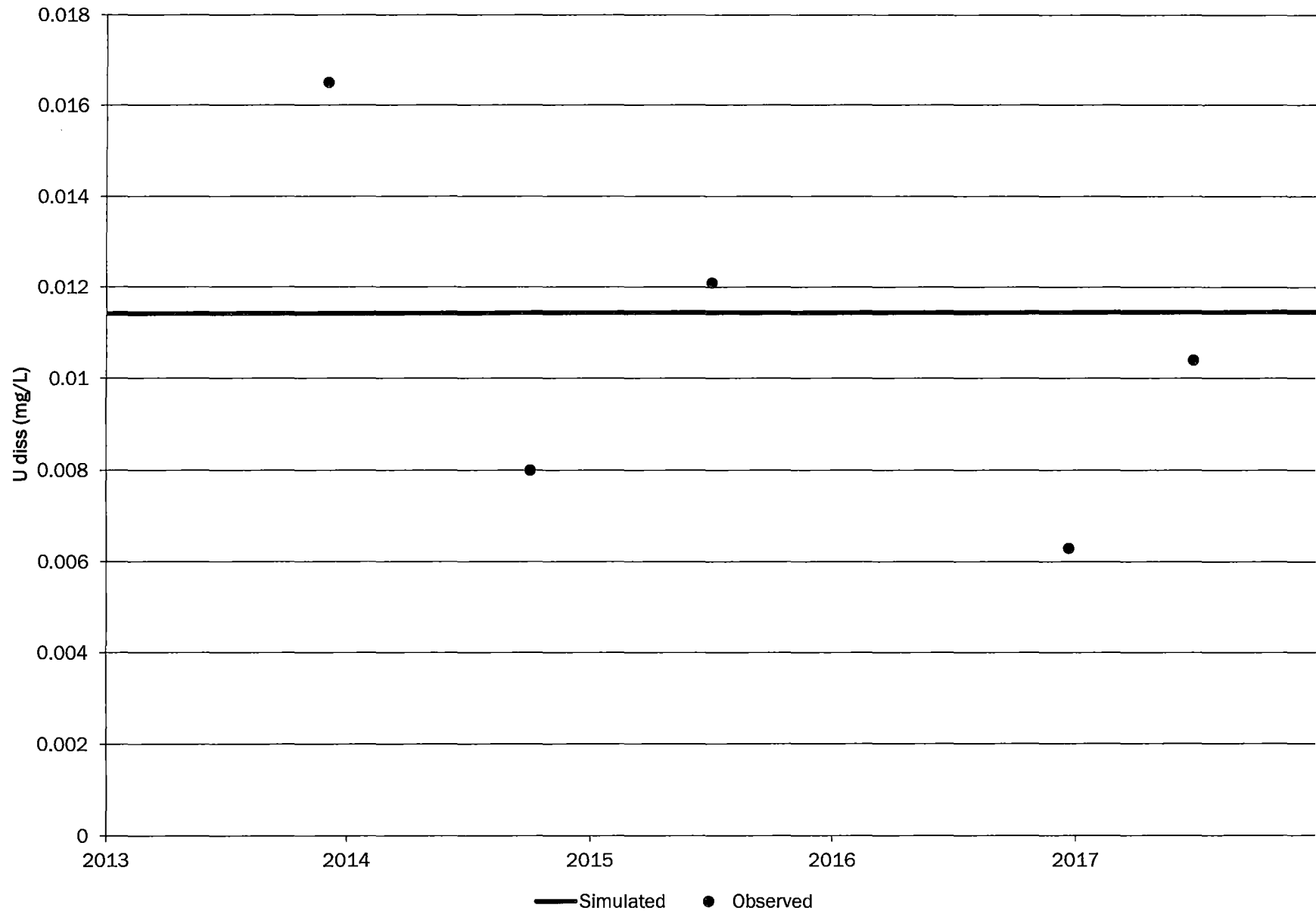
CW28-MC



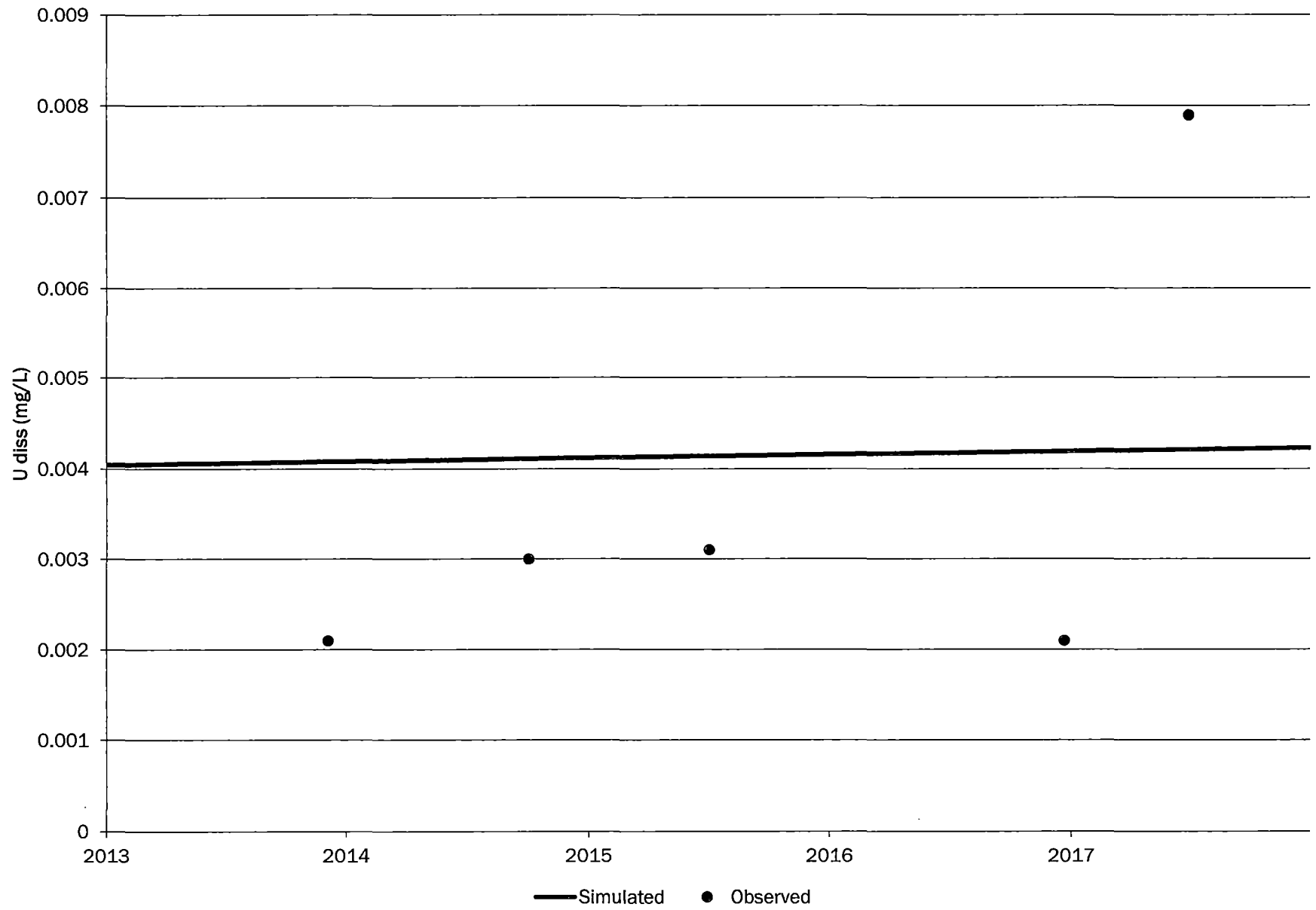
CW29-LC



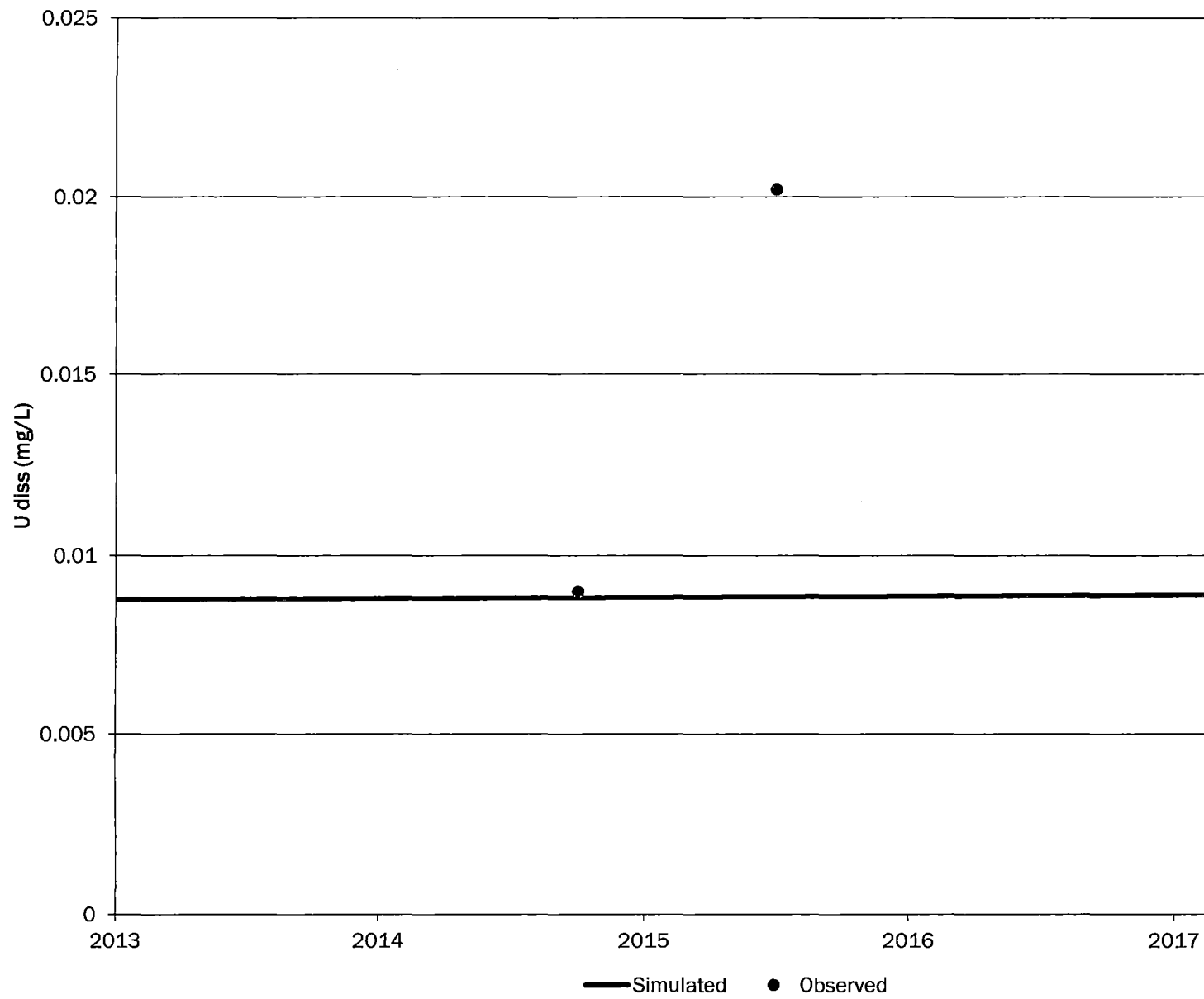
CW31-LC



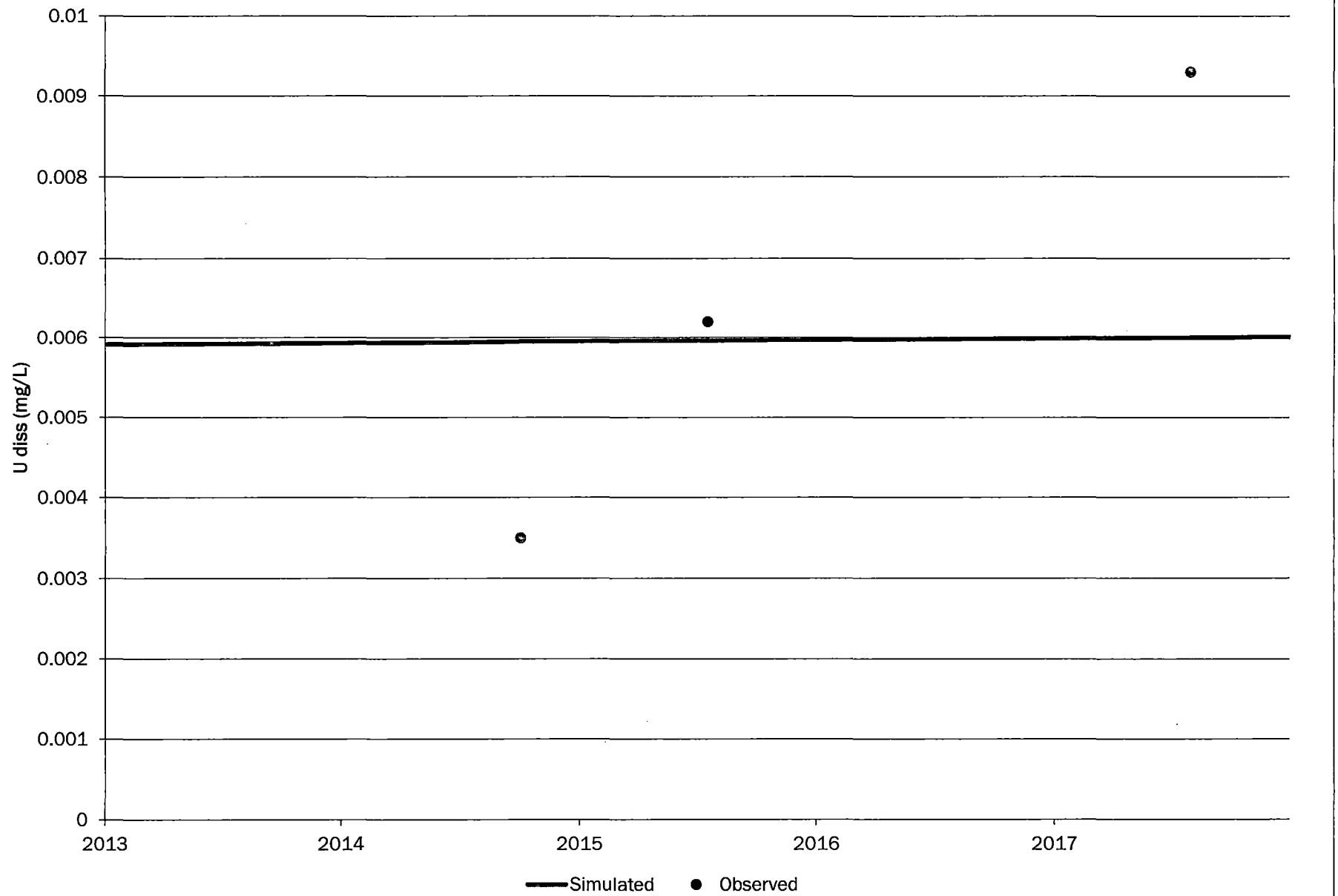
CW32-LC



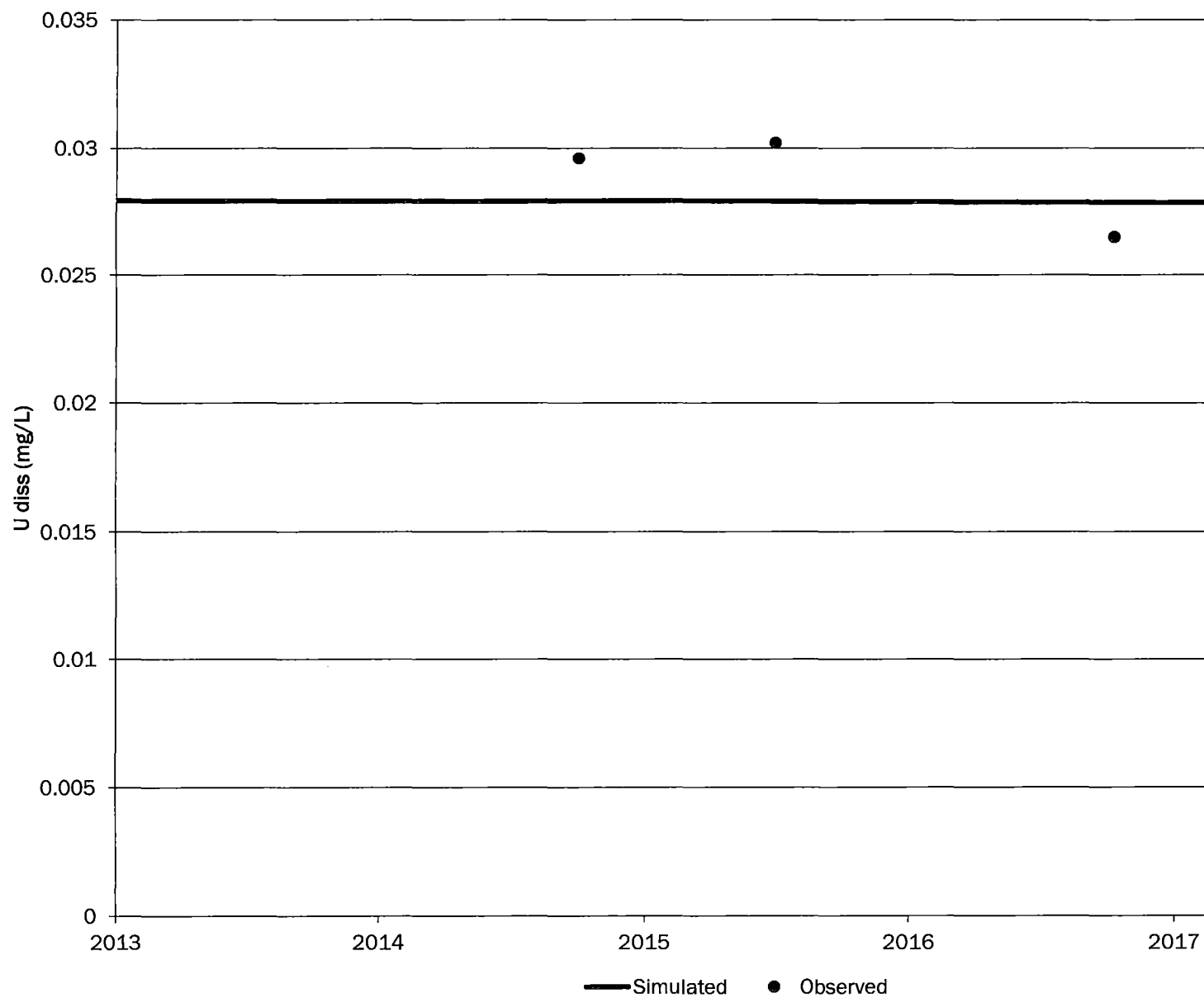
CW33-LC



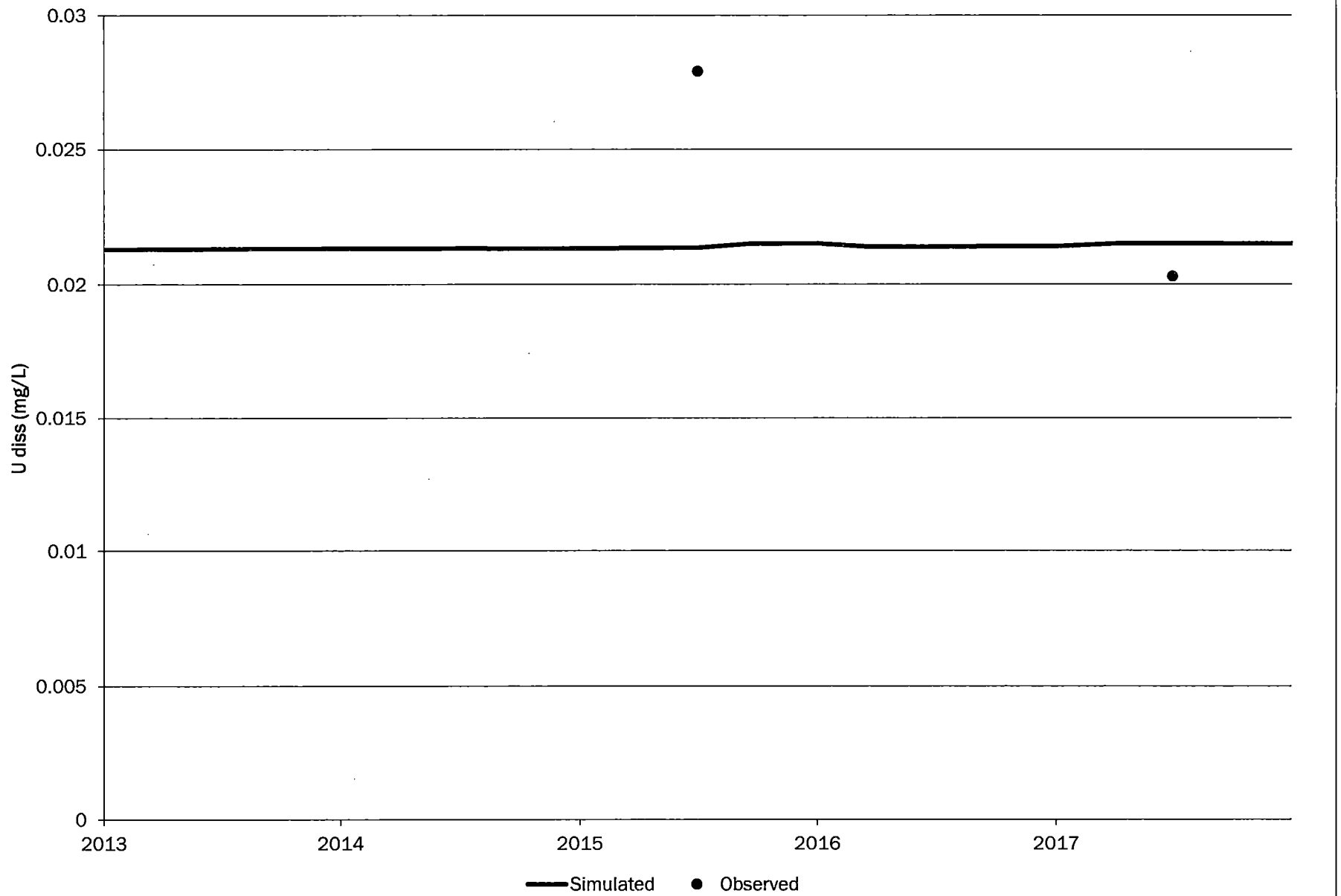
CW36-LC



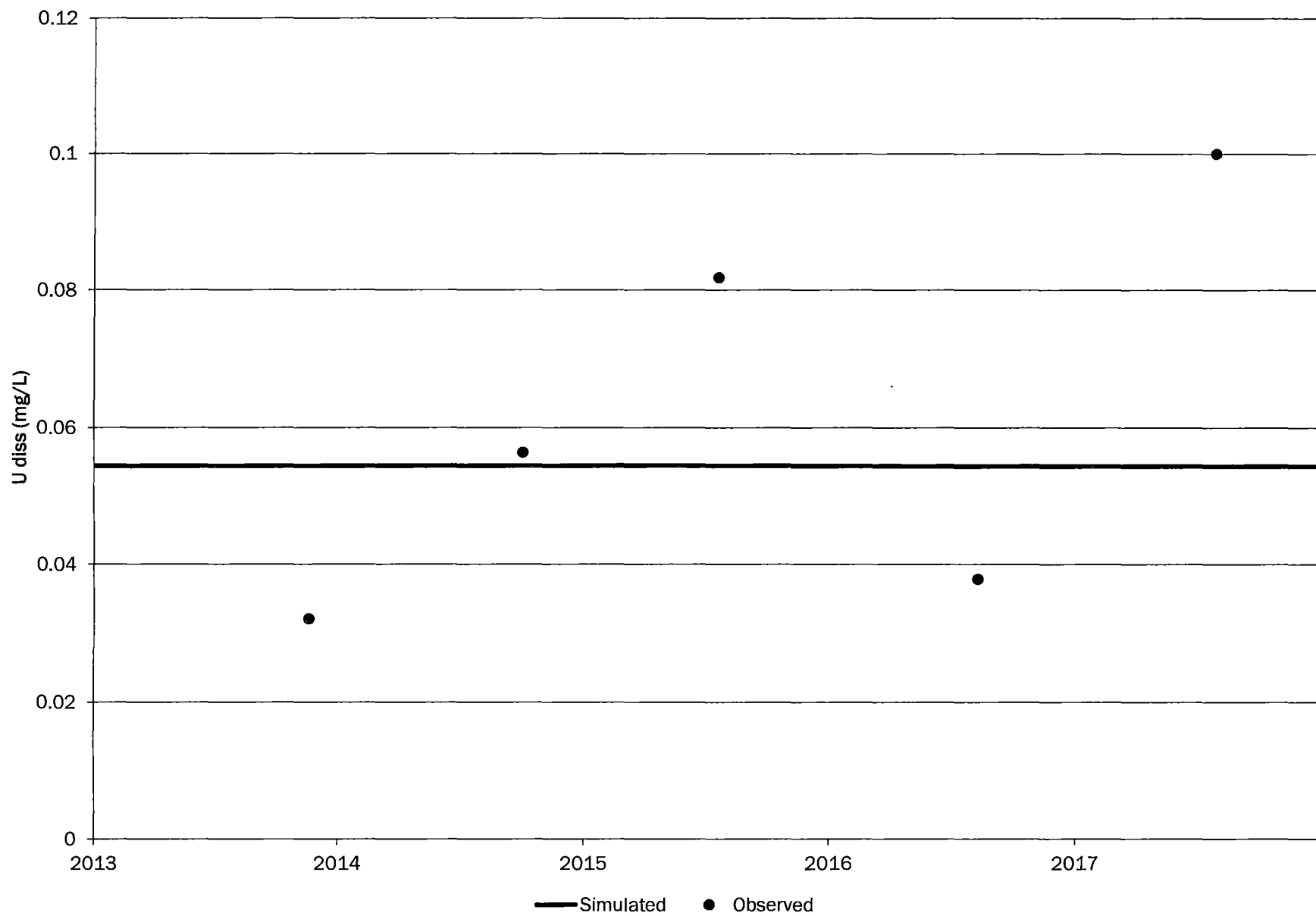
CW37-LC



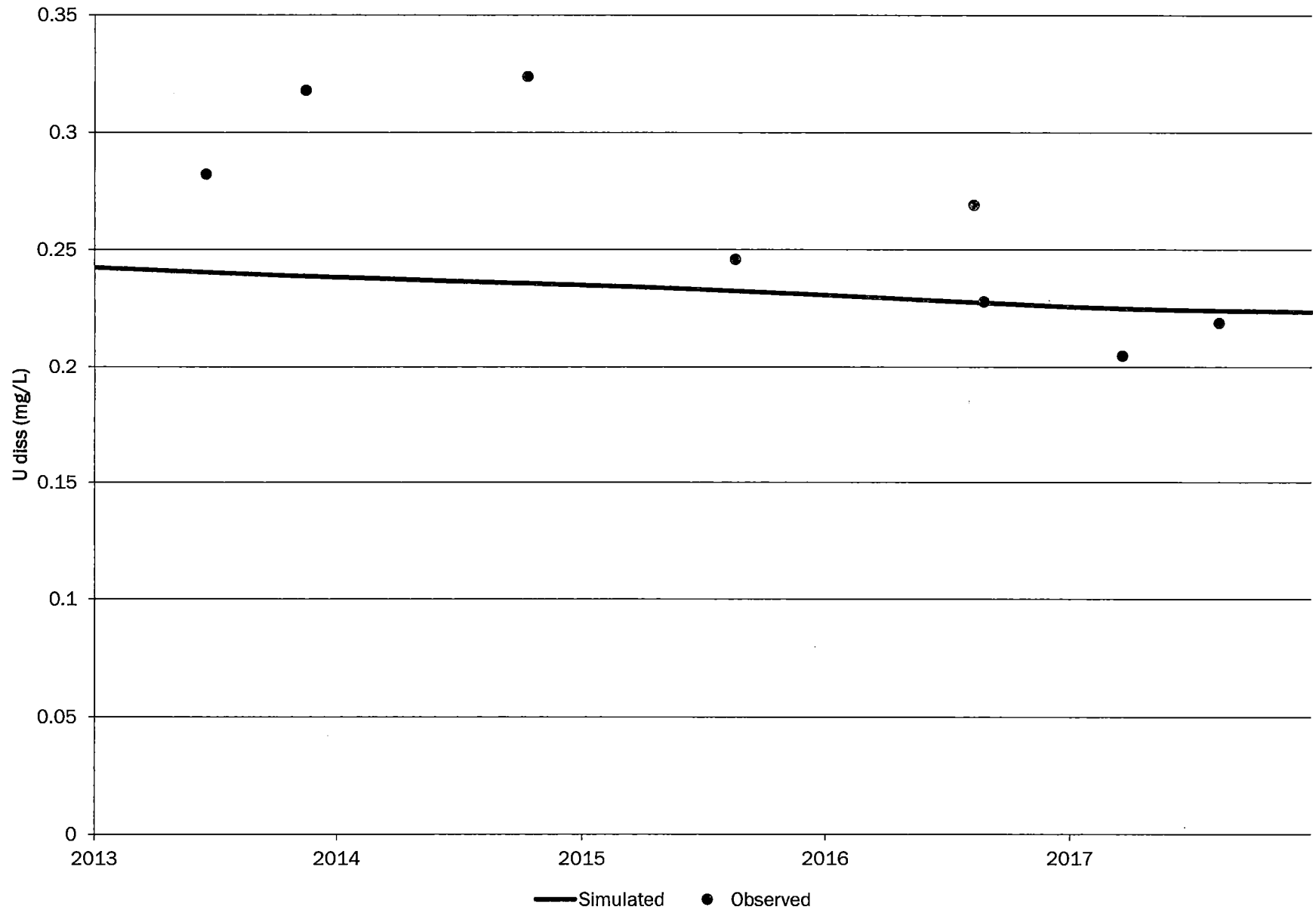
CW40-UC



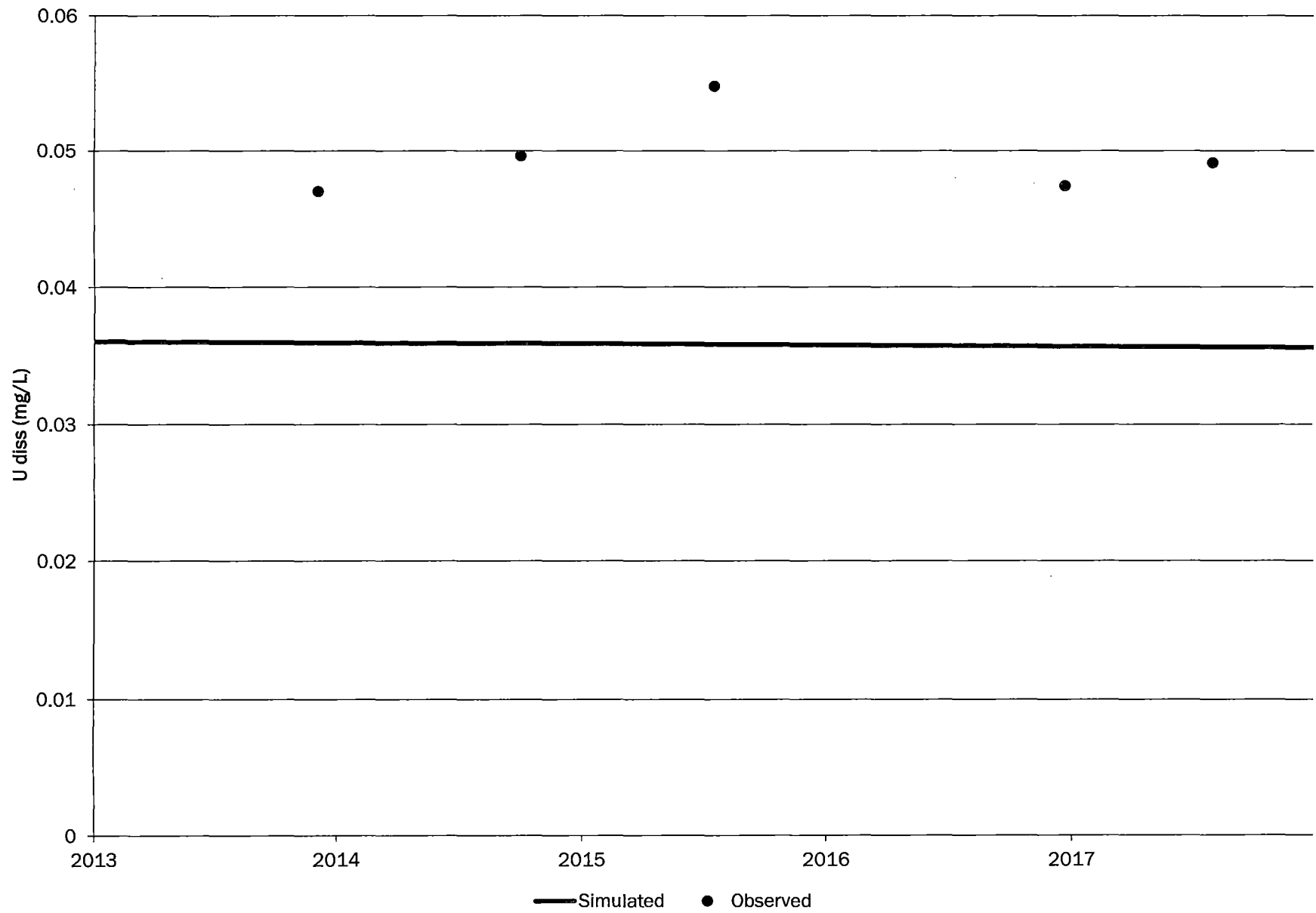
CW41-LC



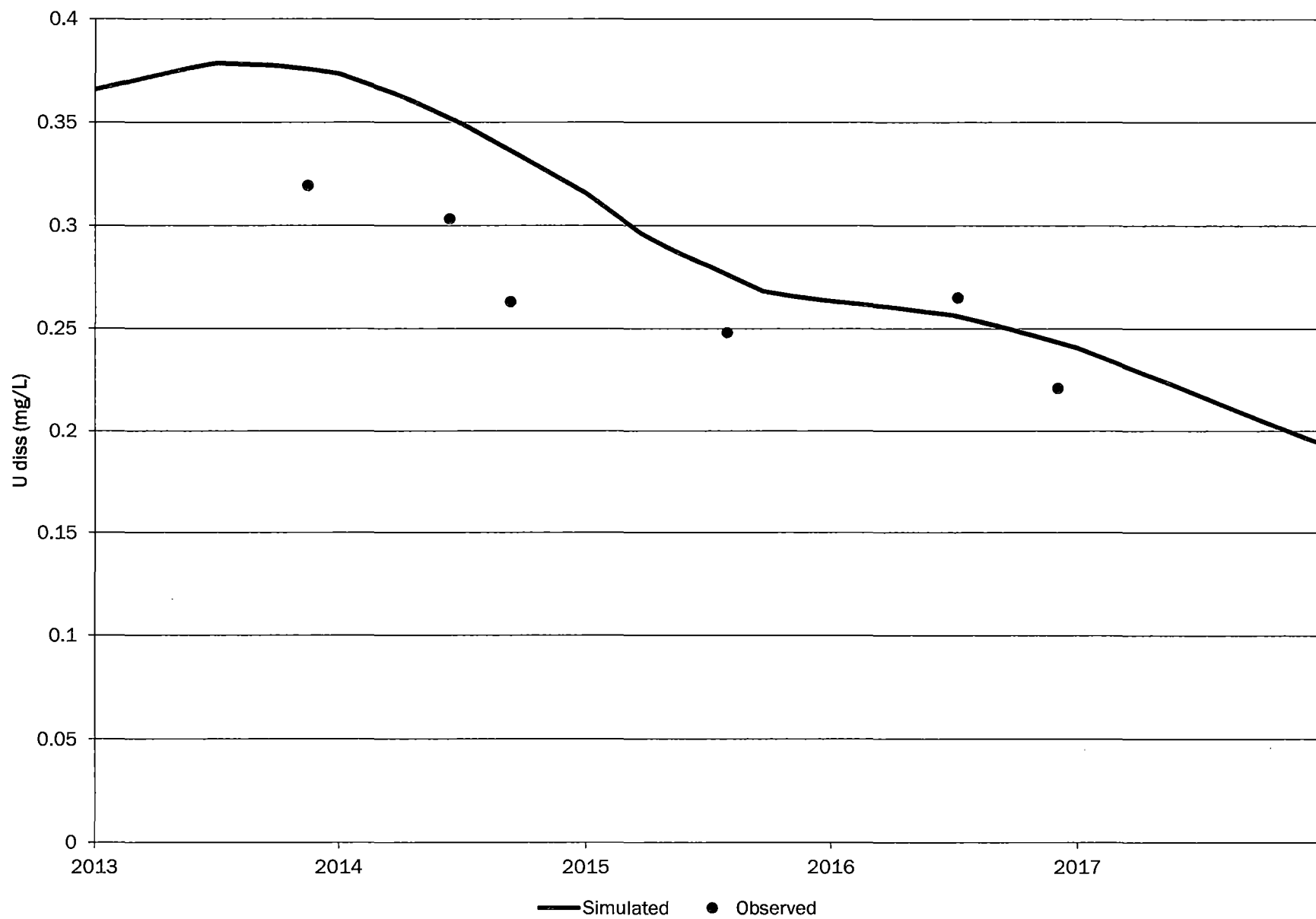
CW42-LC



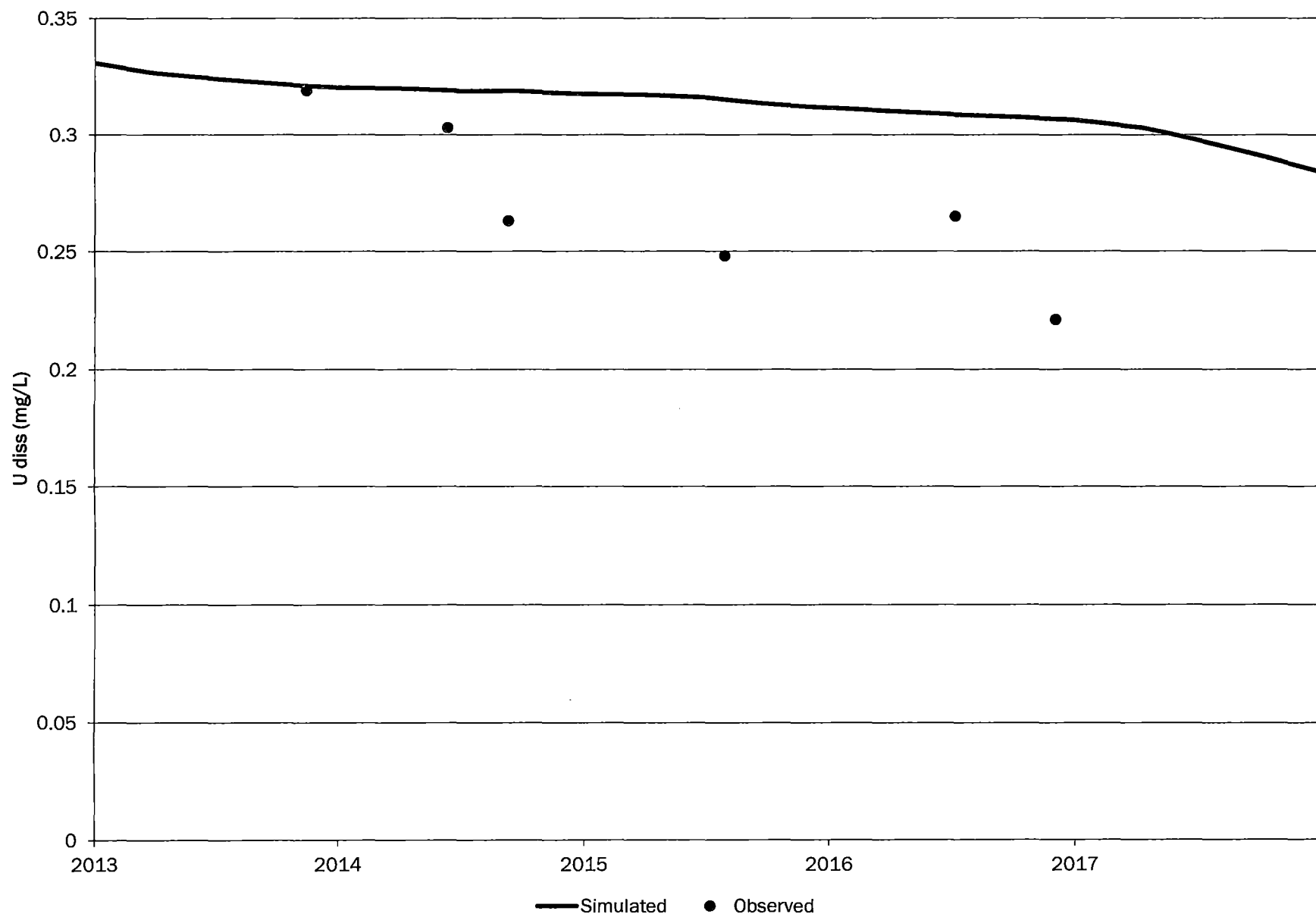
CW43-LC



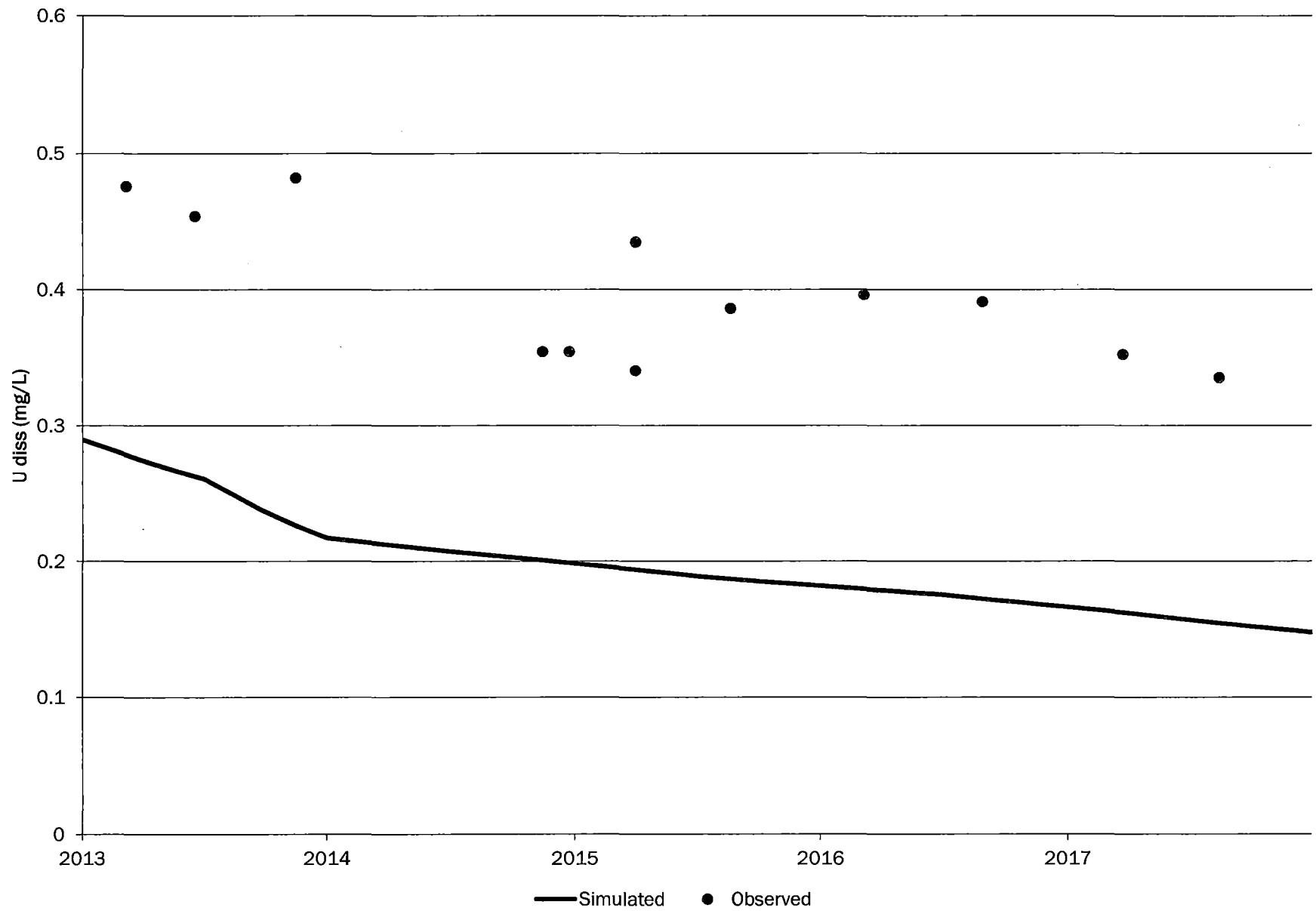
CW44-AI



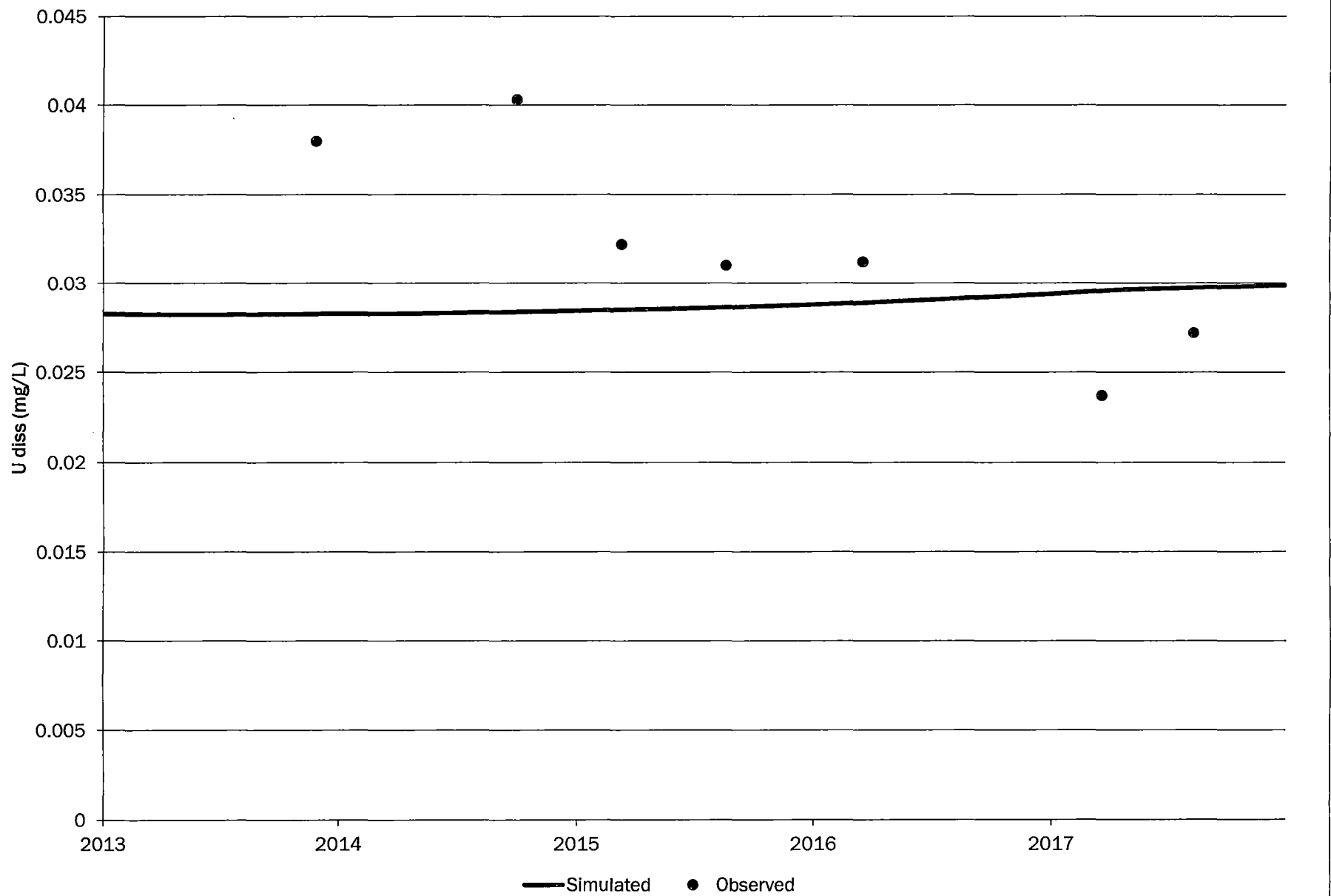
CW44-MC



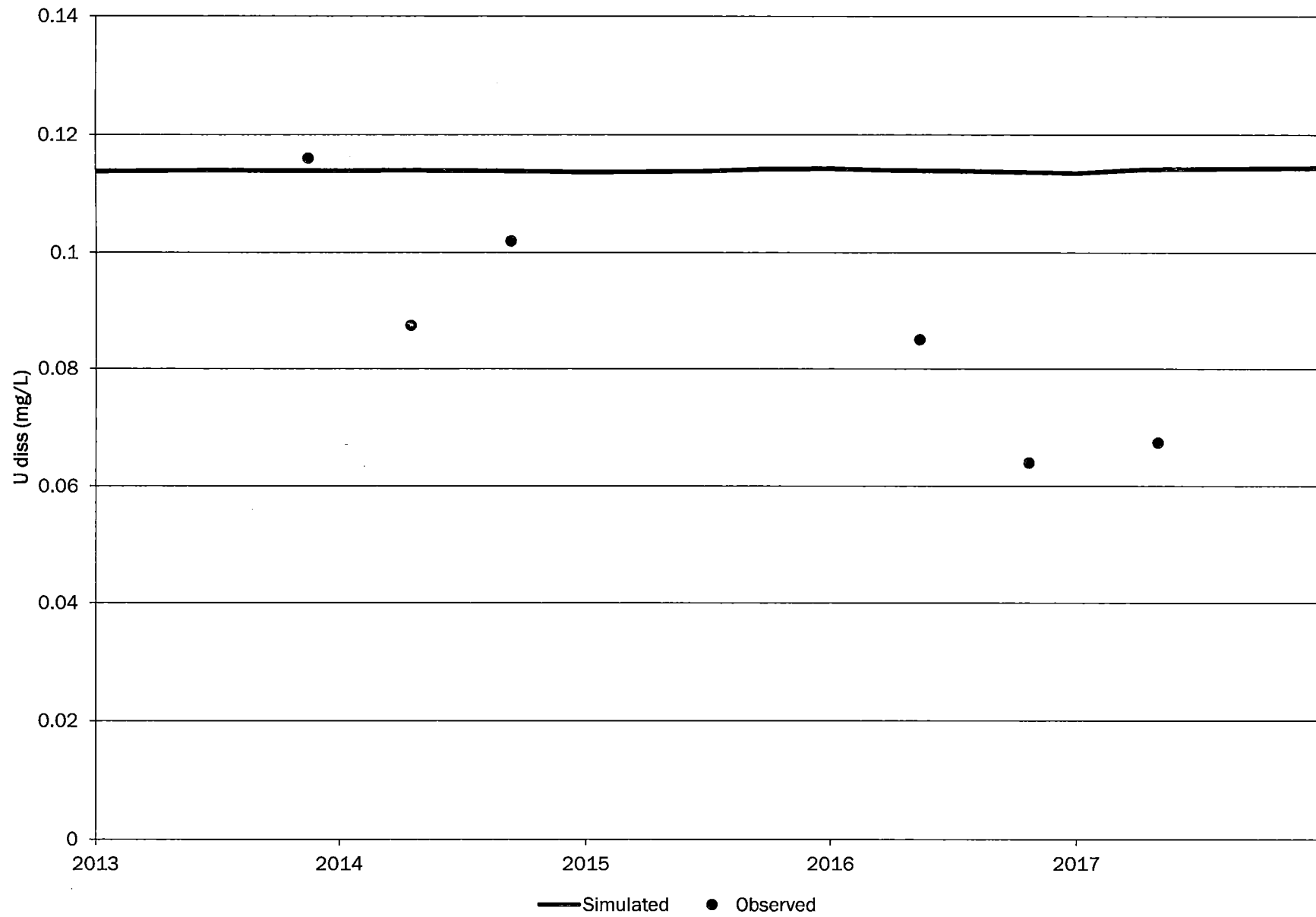
CW45-MC



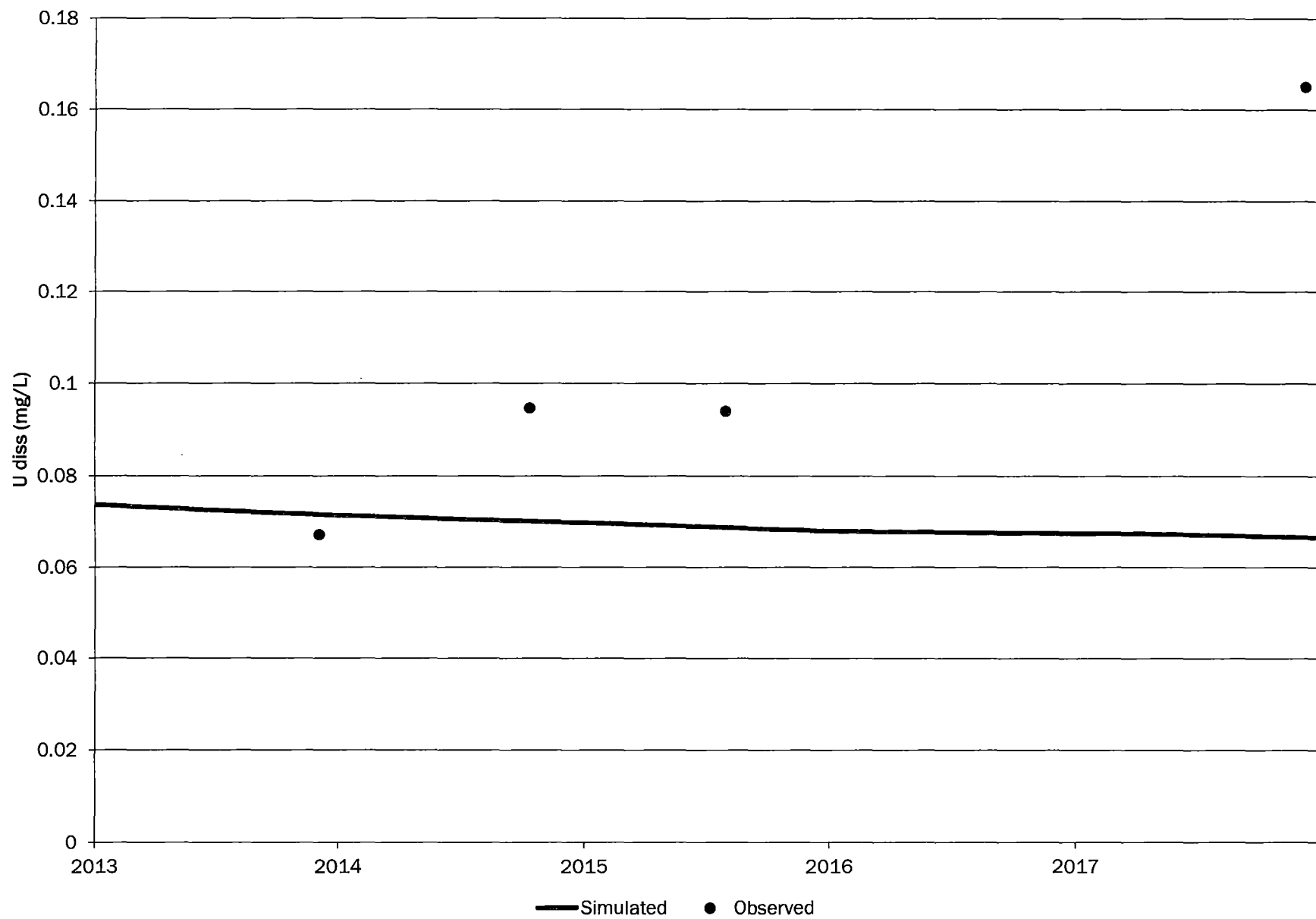
CW50-UC



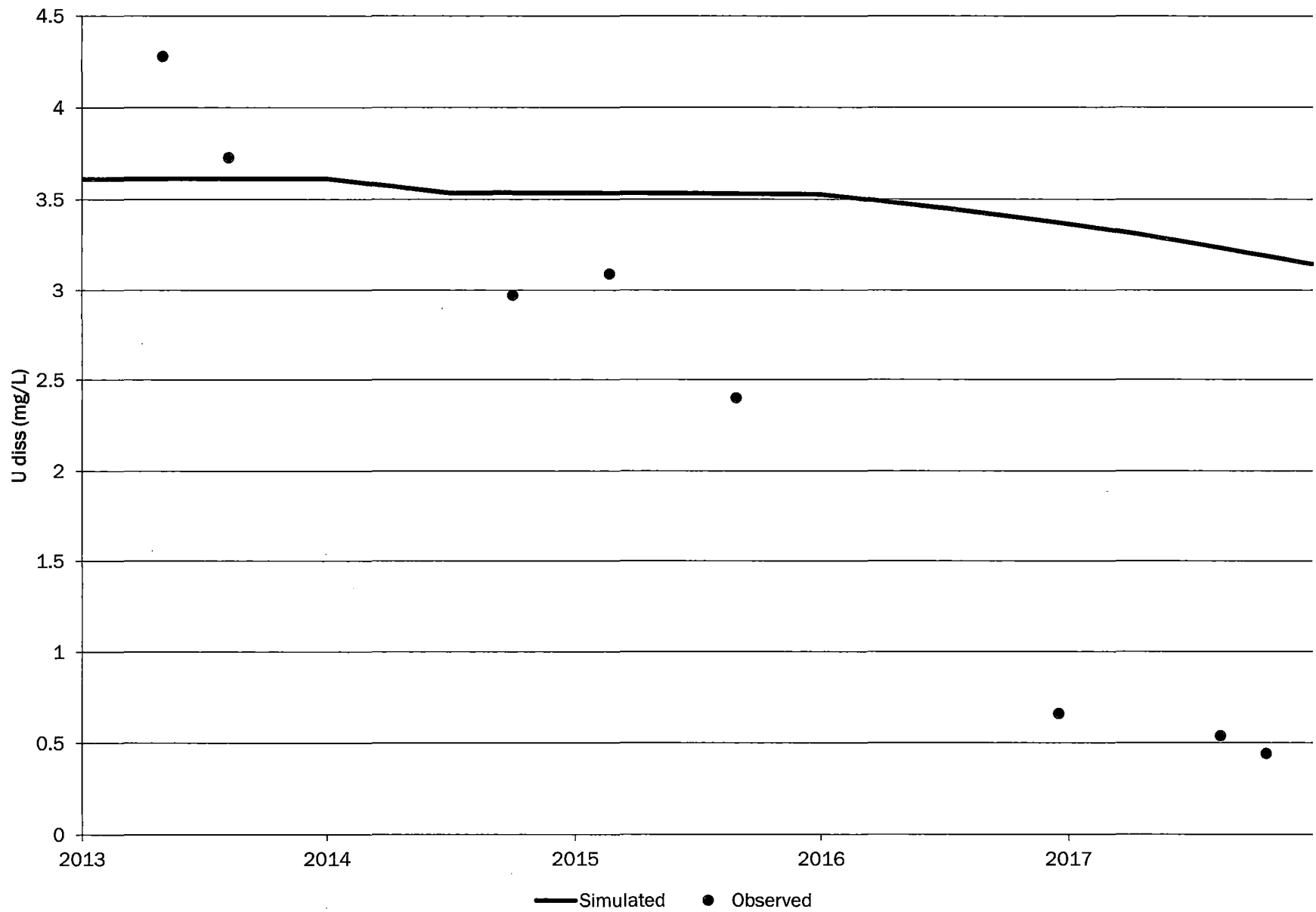
CW53-UC



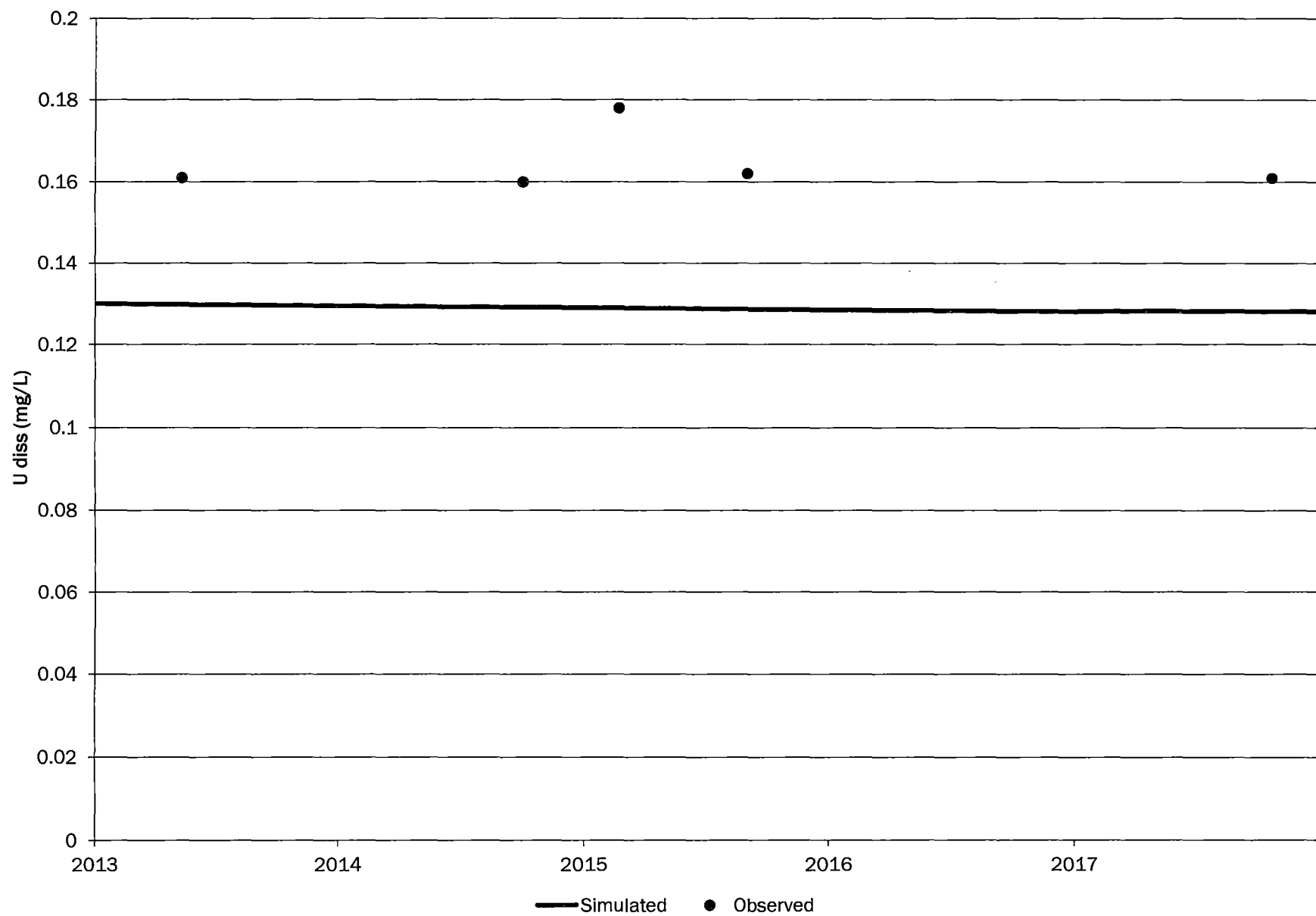
CW55-MC



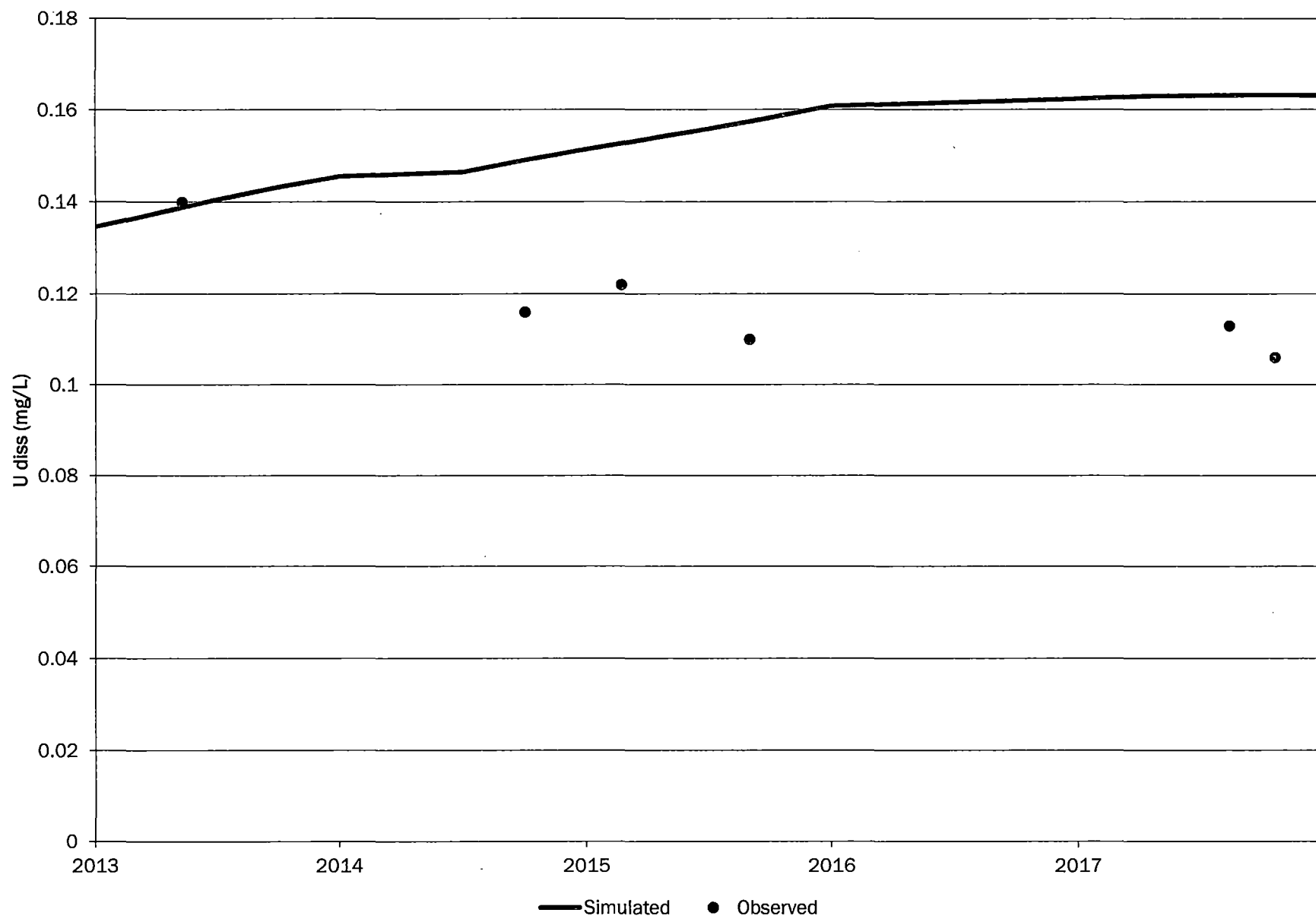
CW56-MC



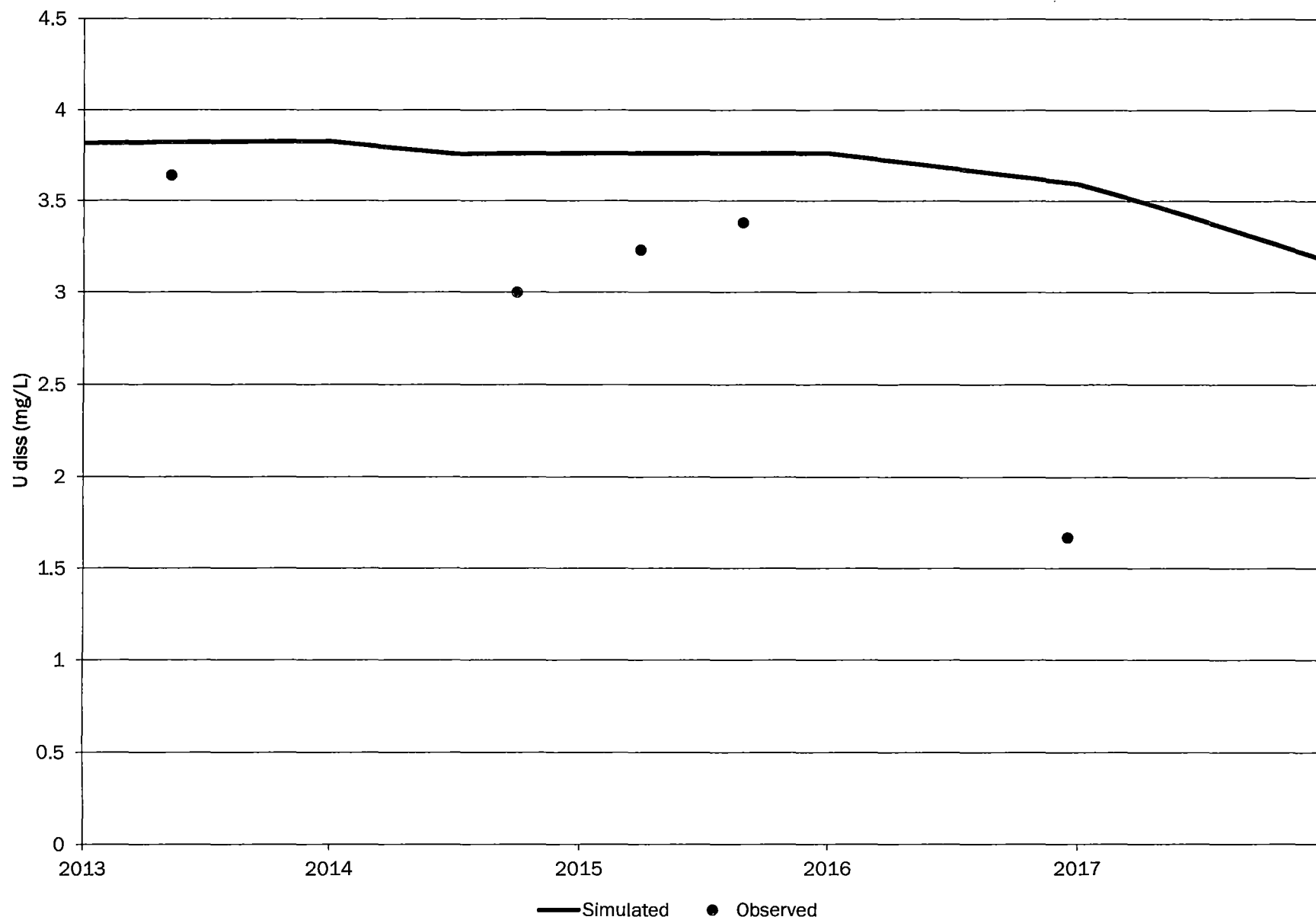
CW57-MC



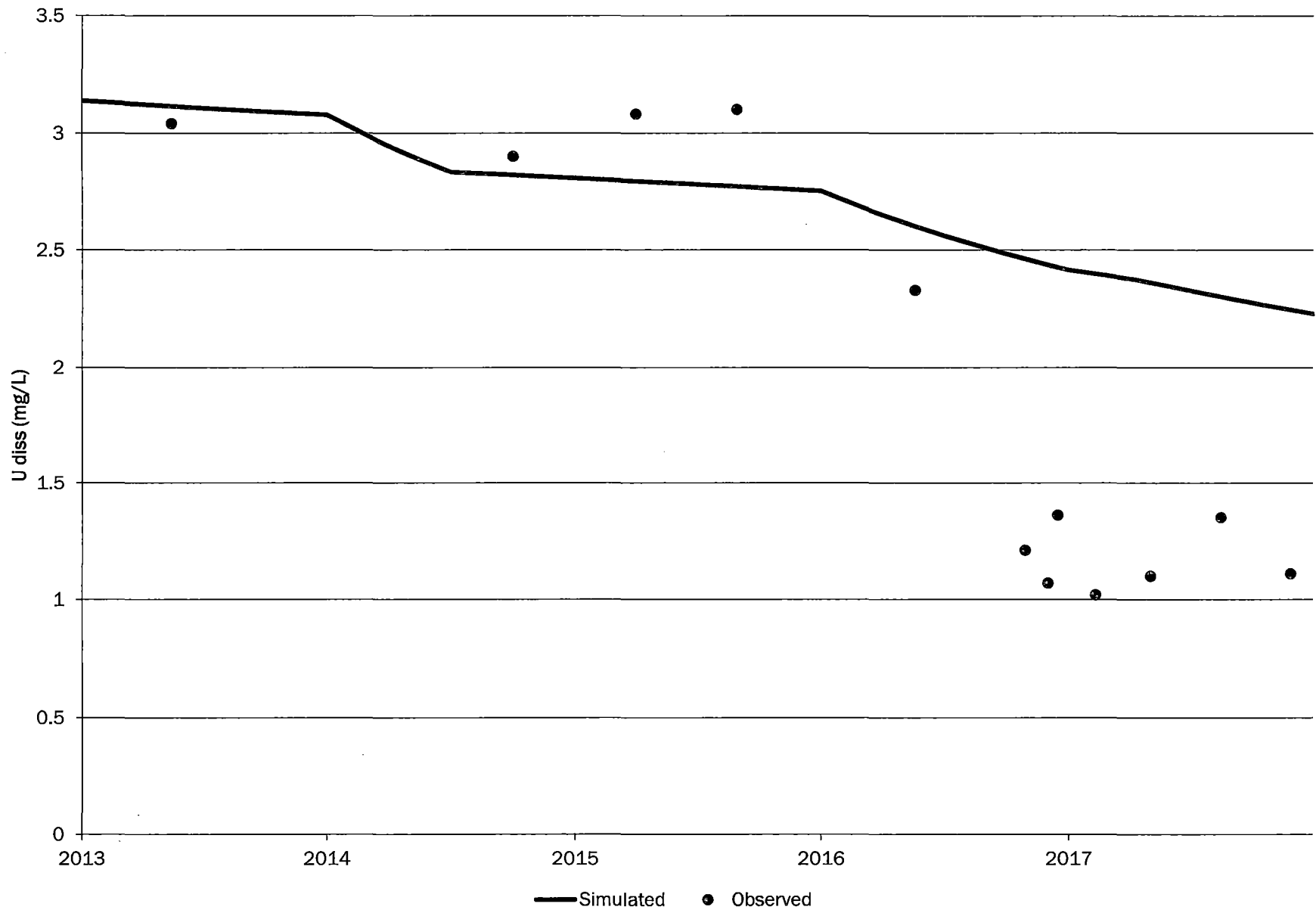
CW60-MC



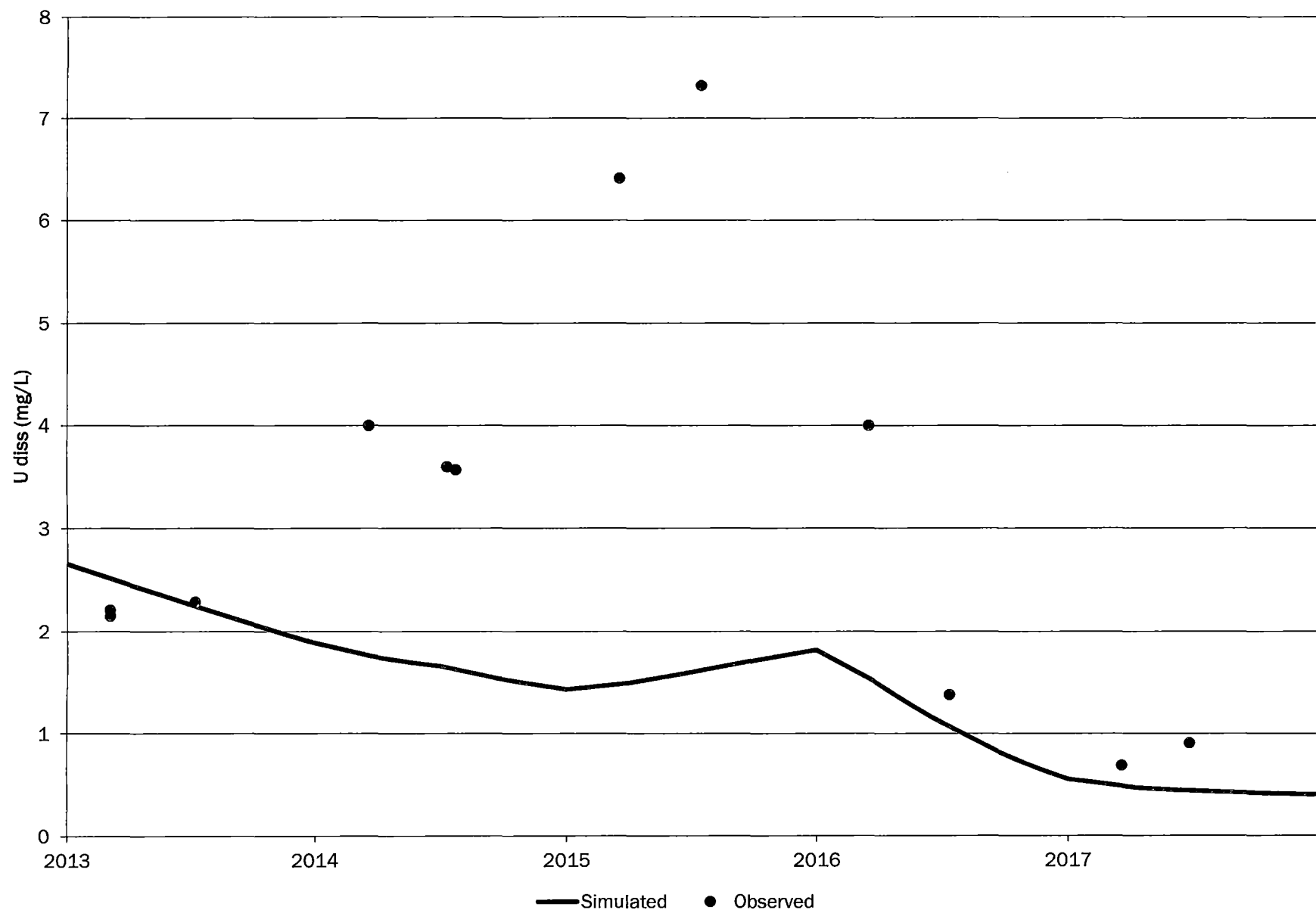
CW61-MC



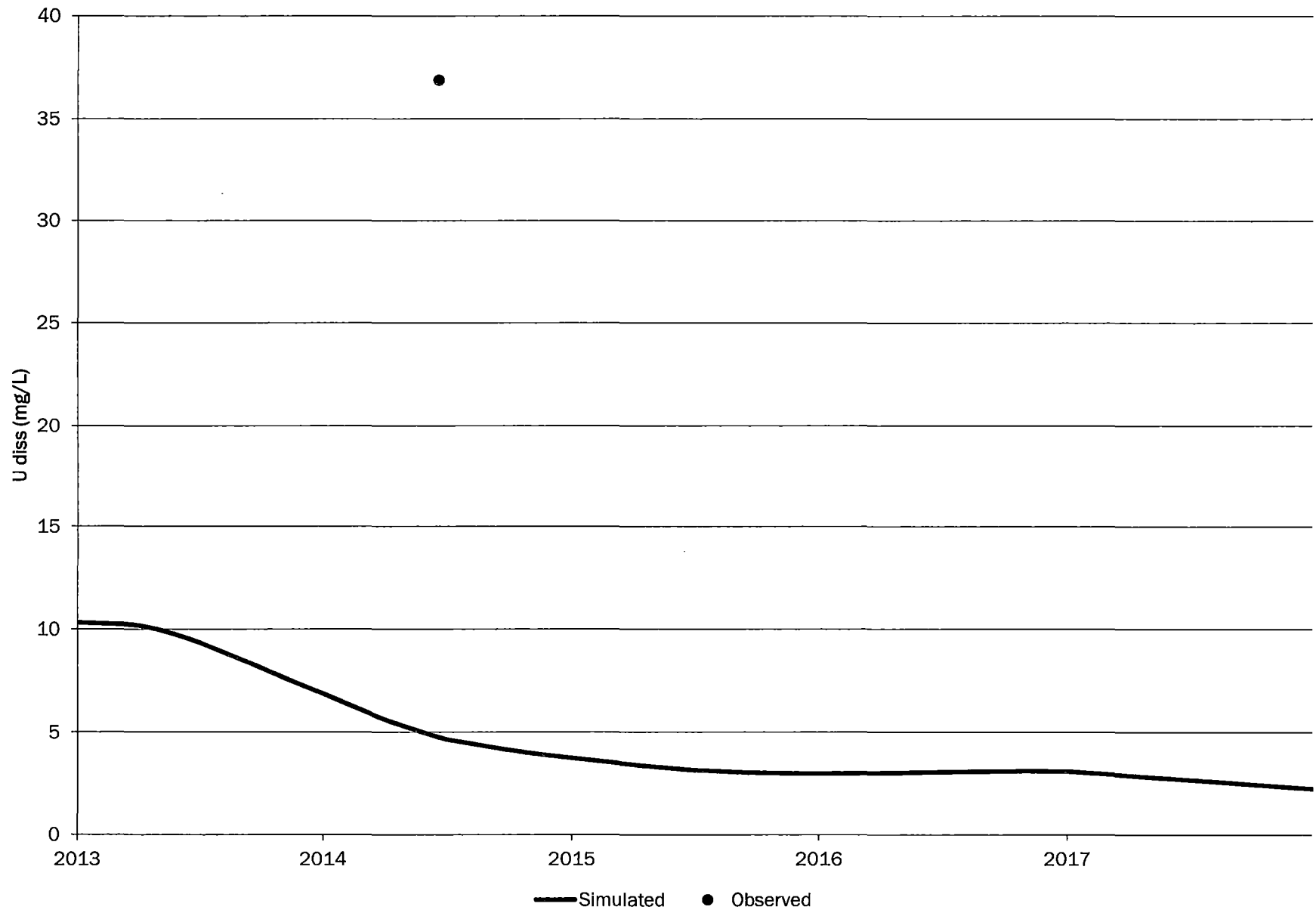
CW62-MC



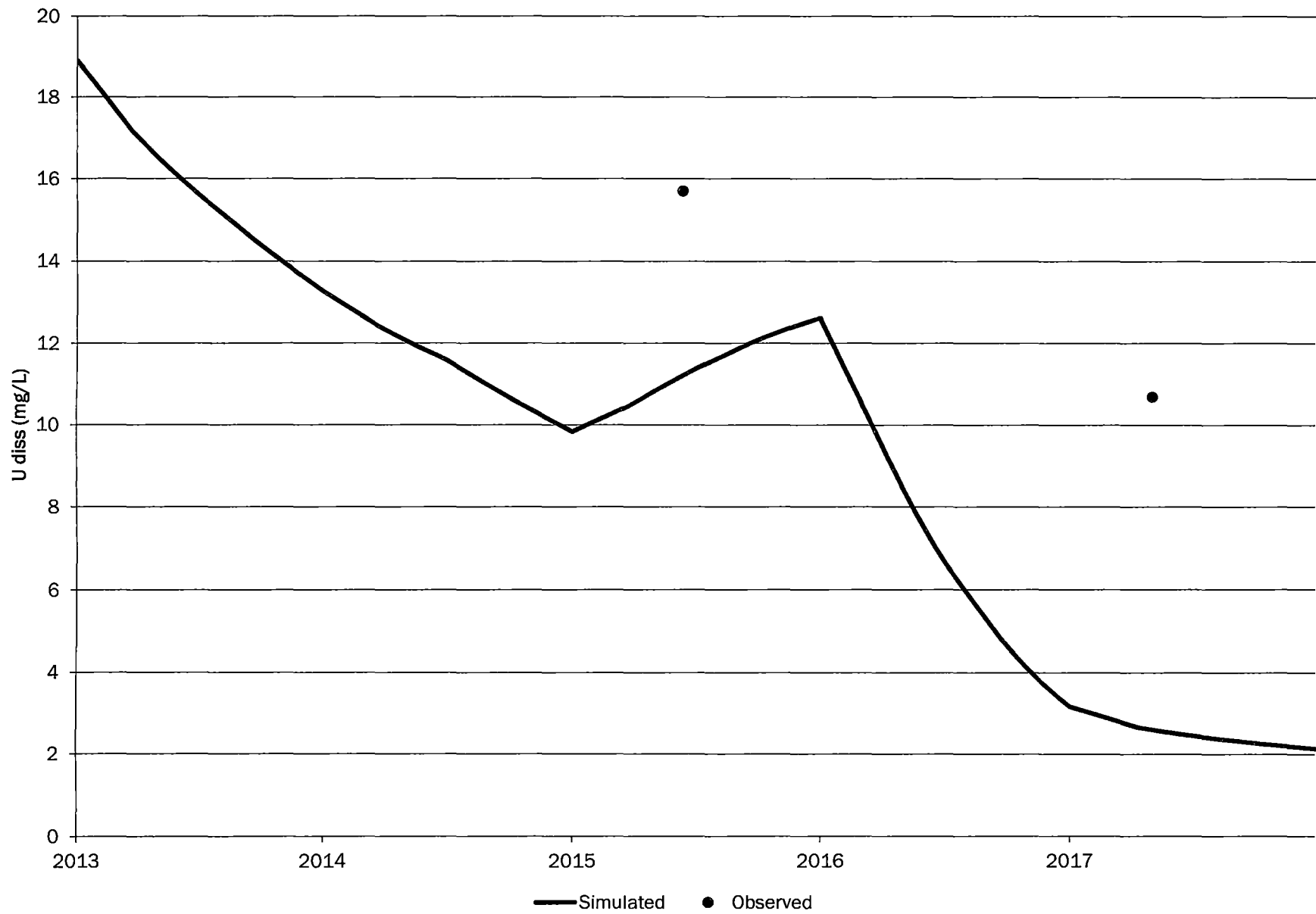
D1-AI



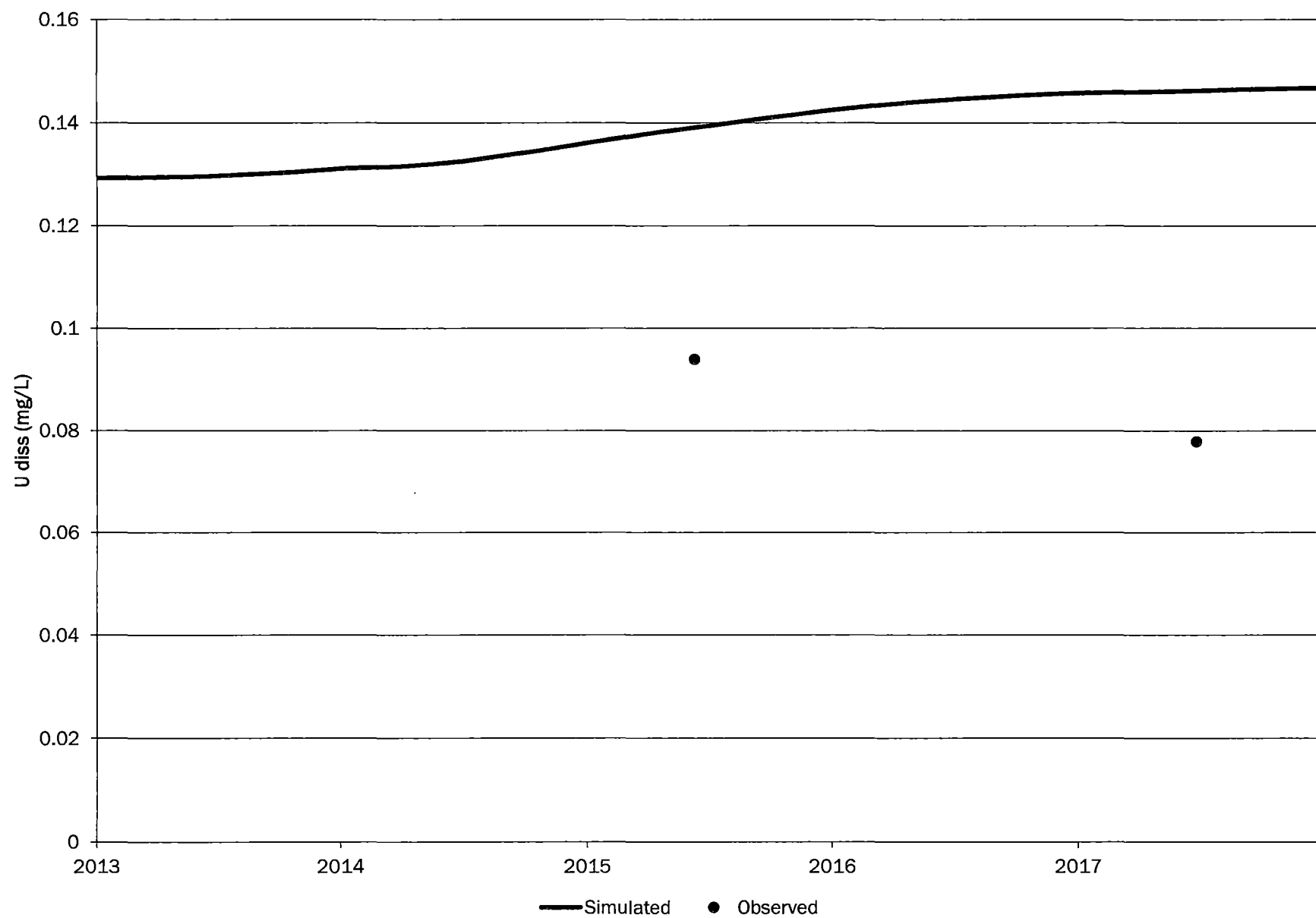
D2-AI



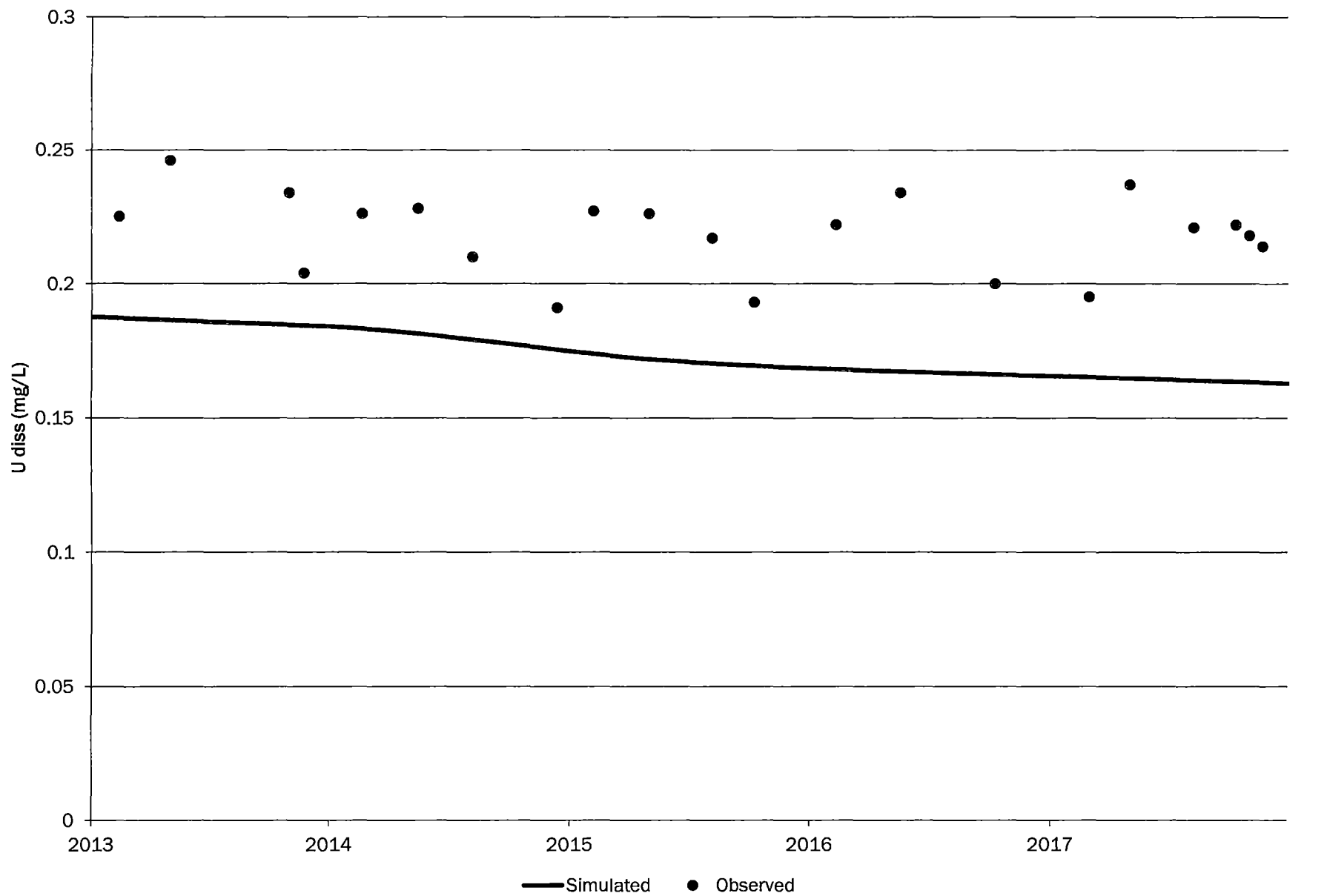
DA3-AI



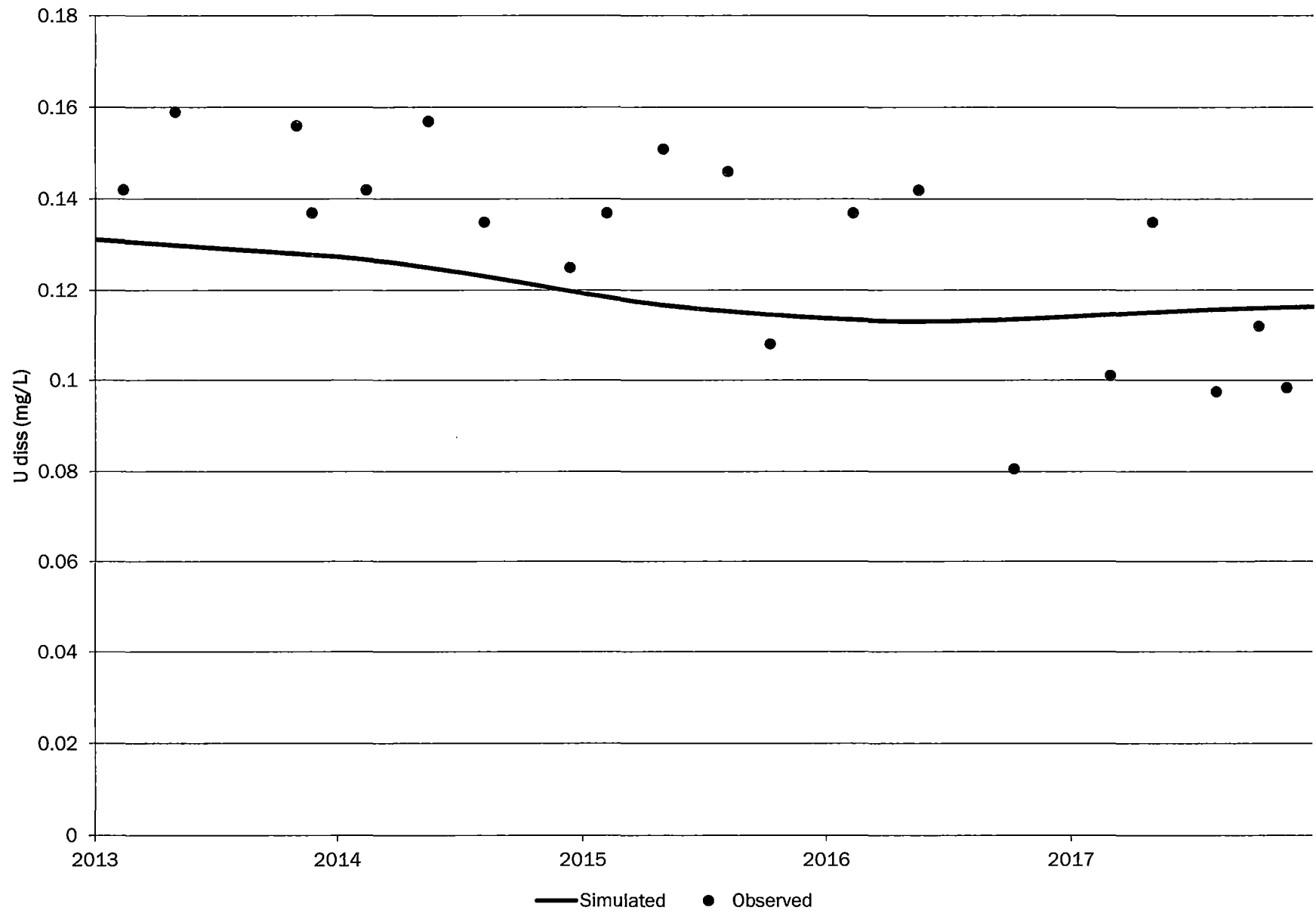
DC-AI



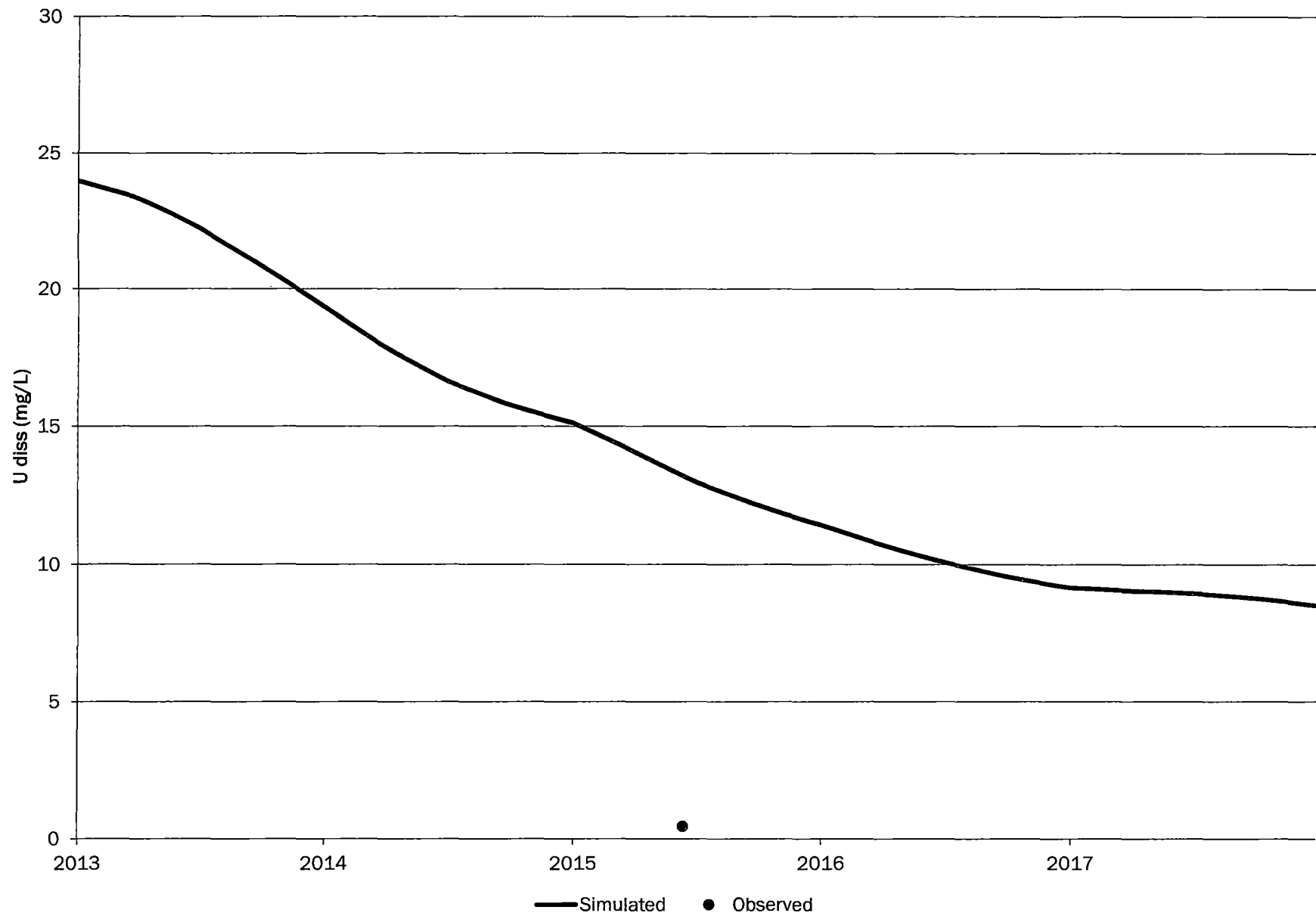
DD2-AI



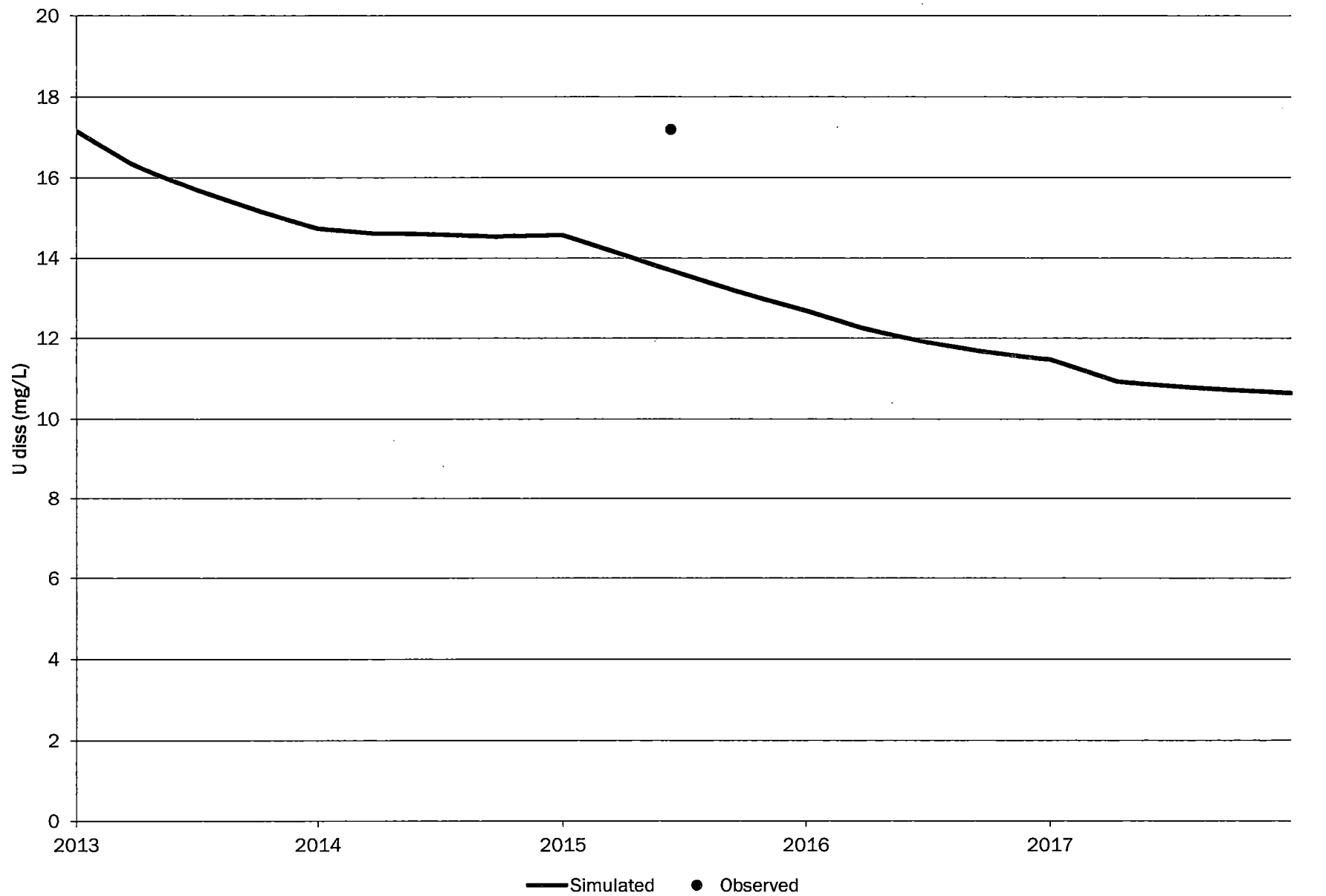
DD-AI



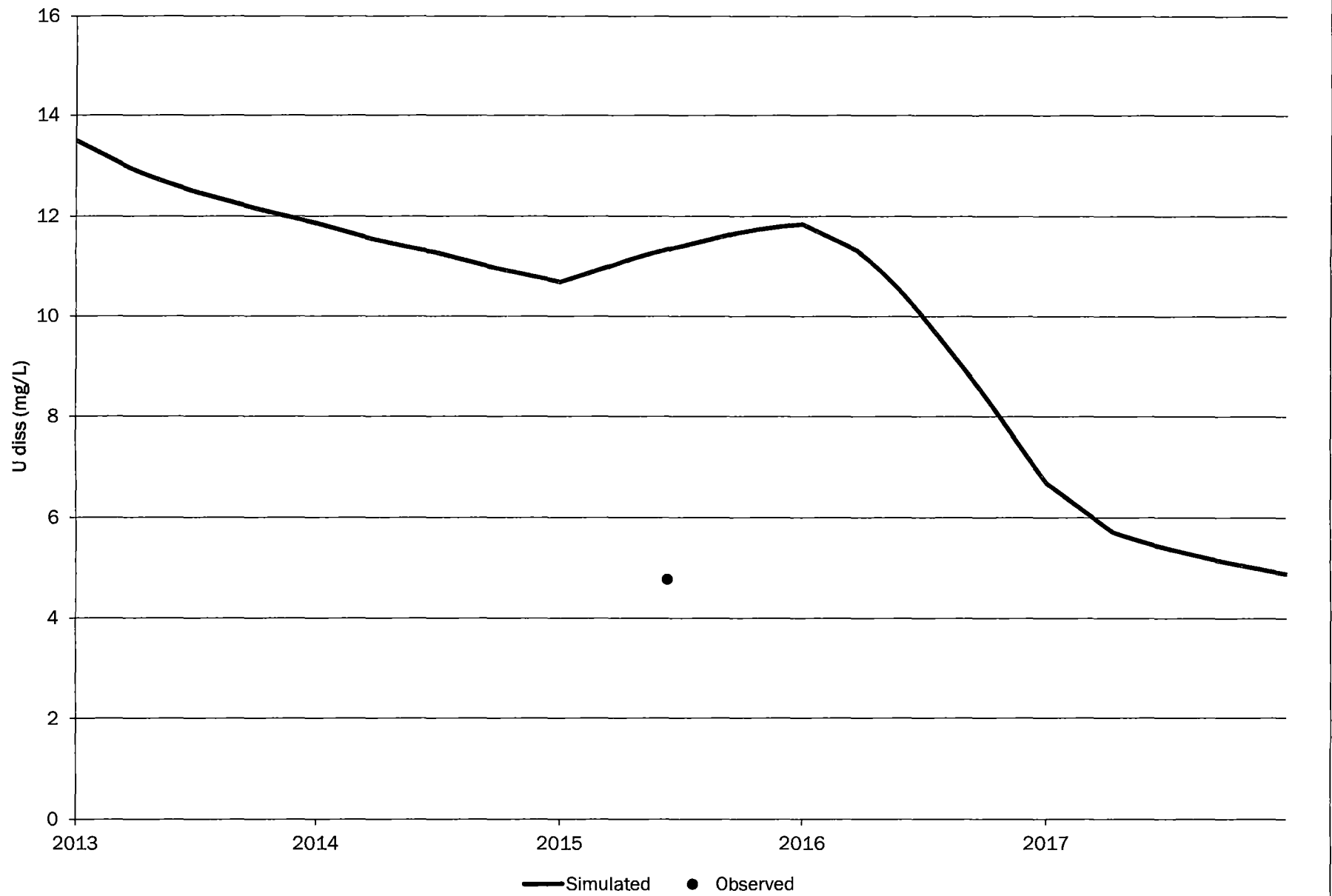
DQ-AI



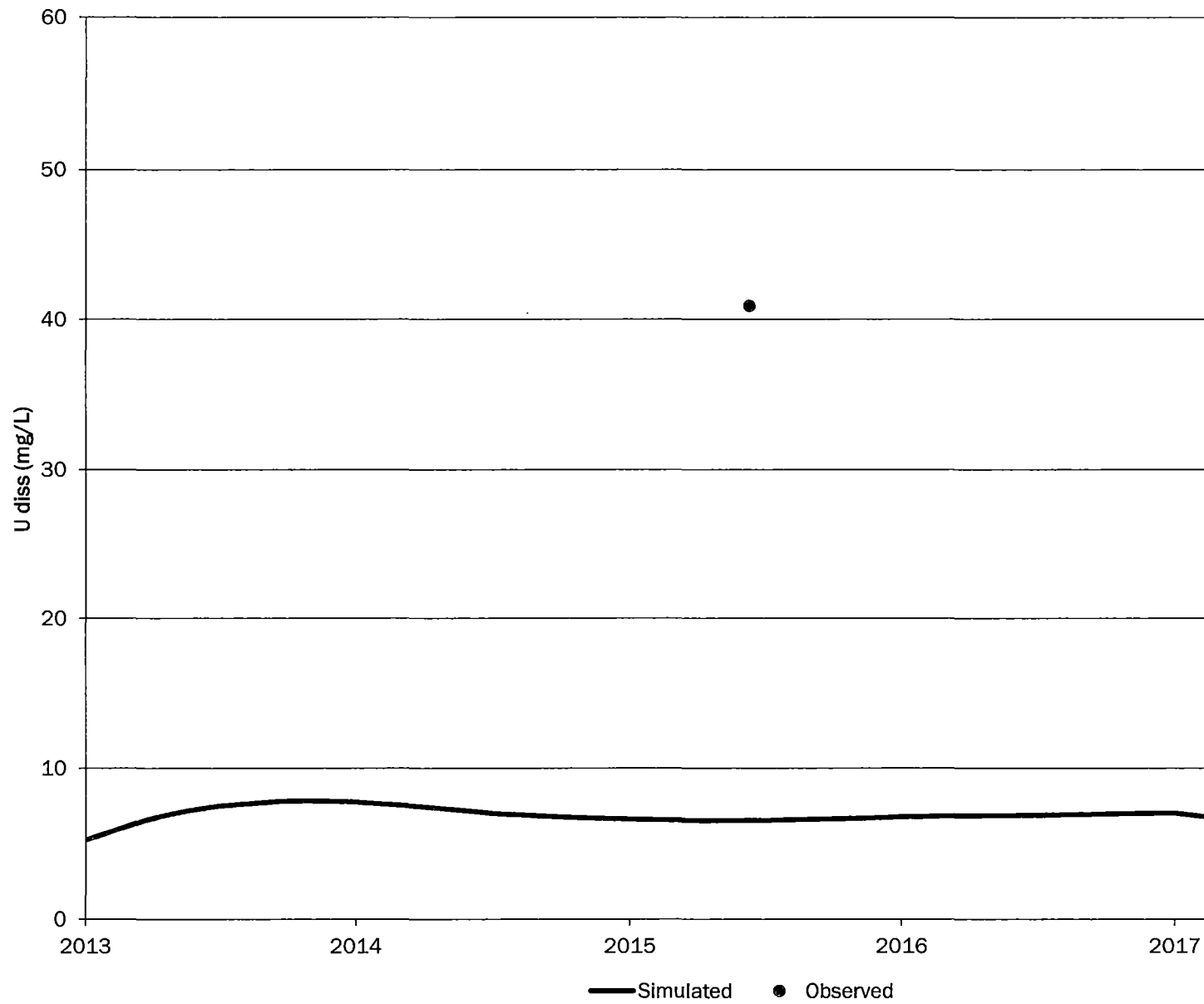
DR-AI



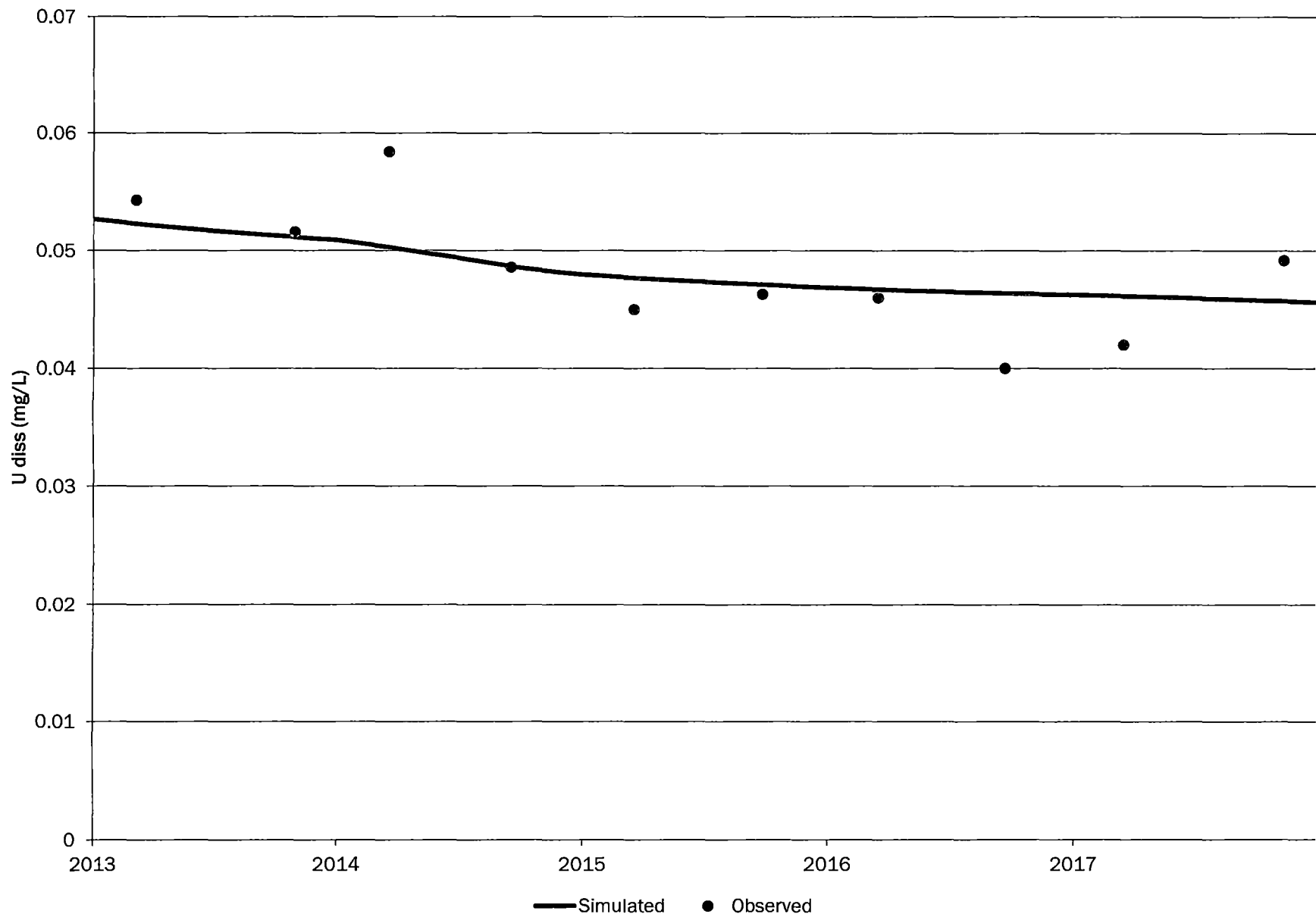
DT-AI



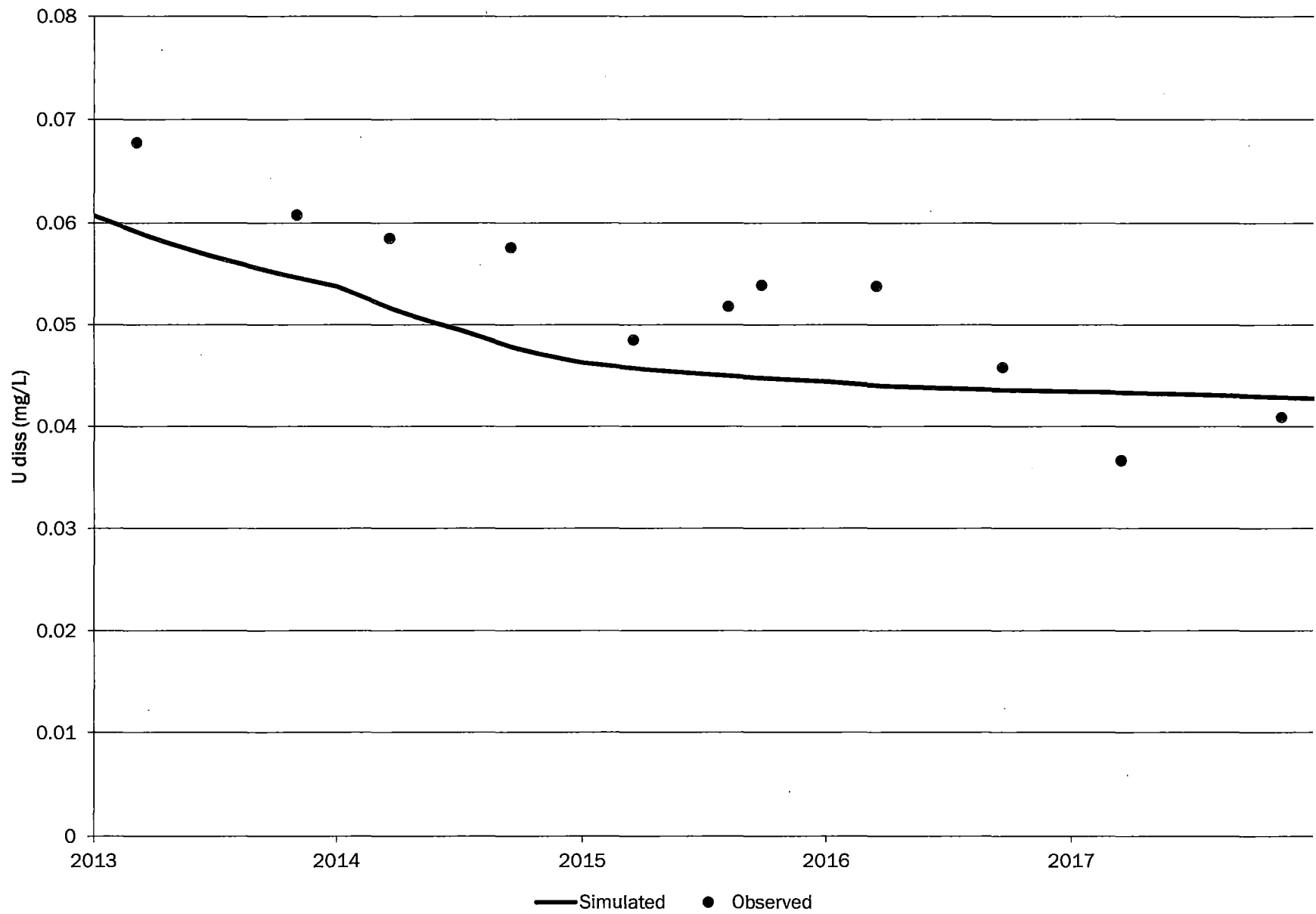
DZ-AI



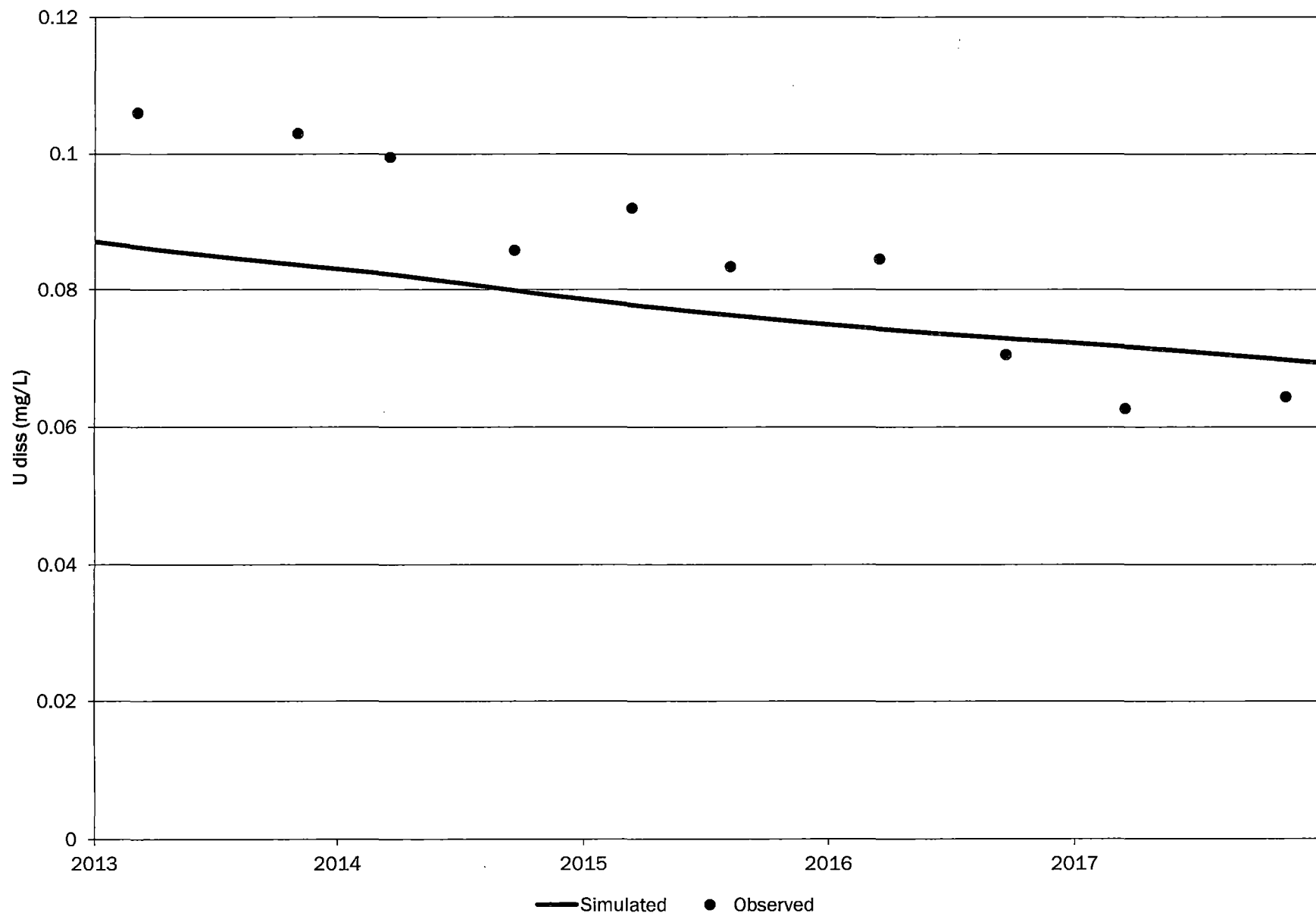
F-AI



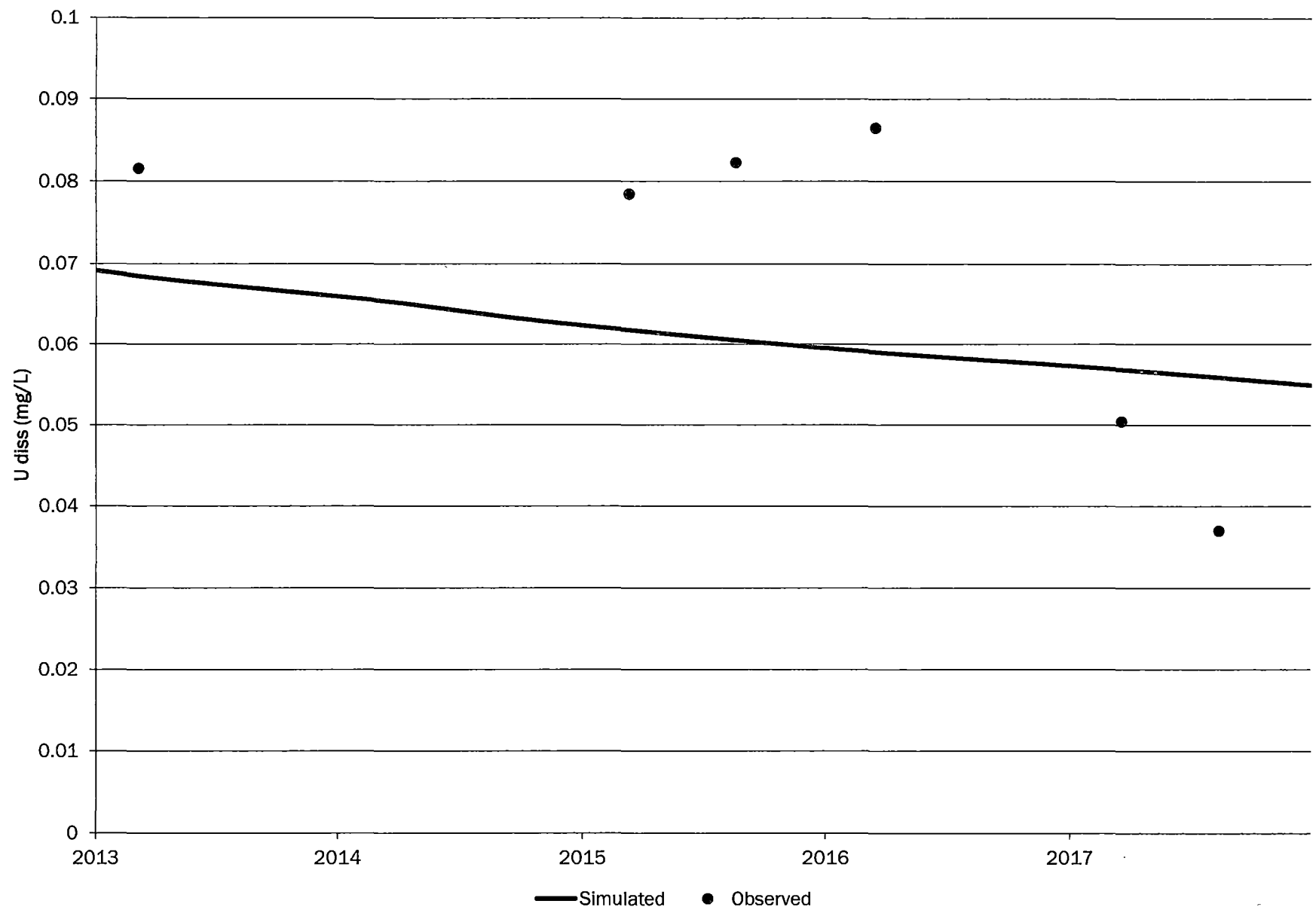
FB-AI



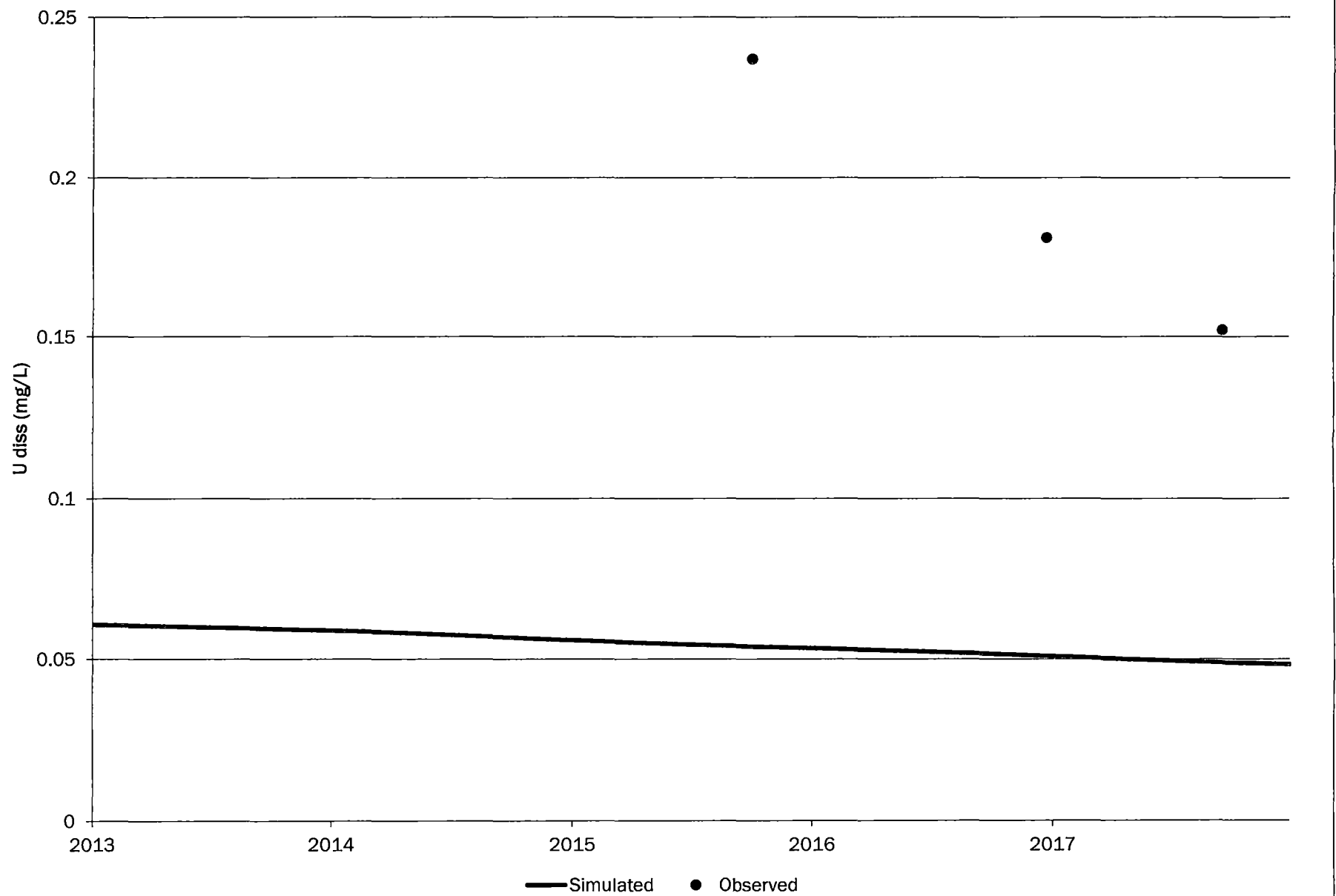
GH-AI



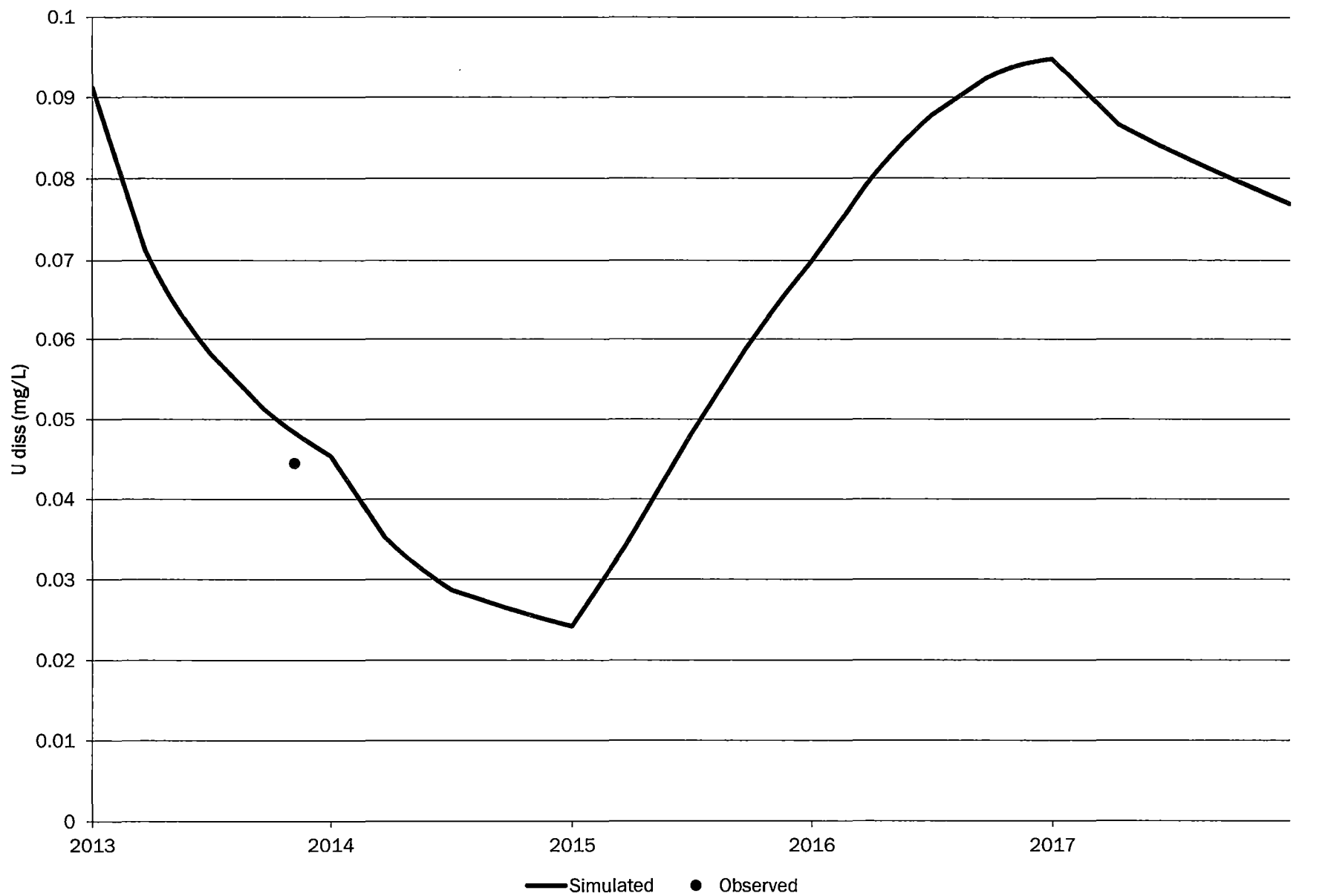
GN-AI



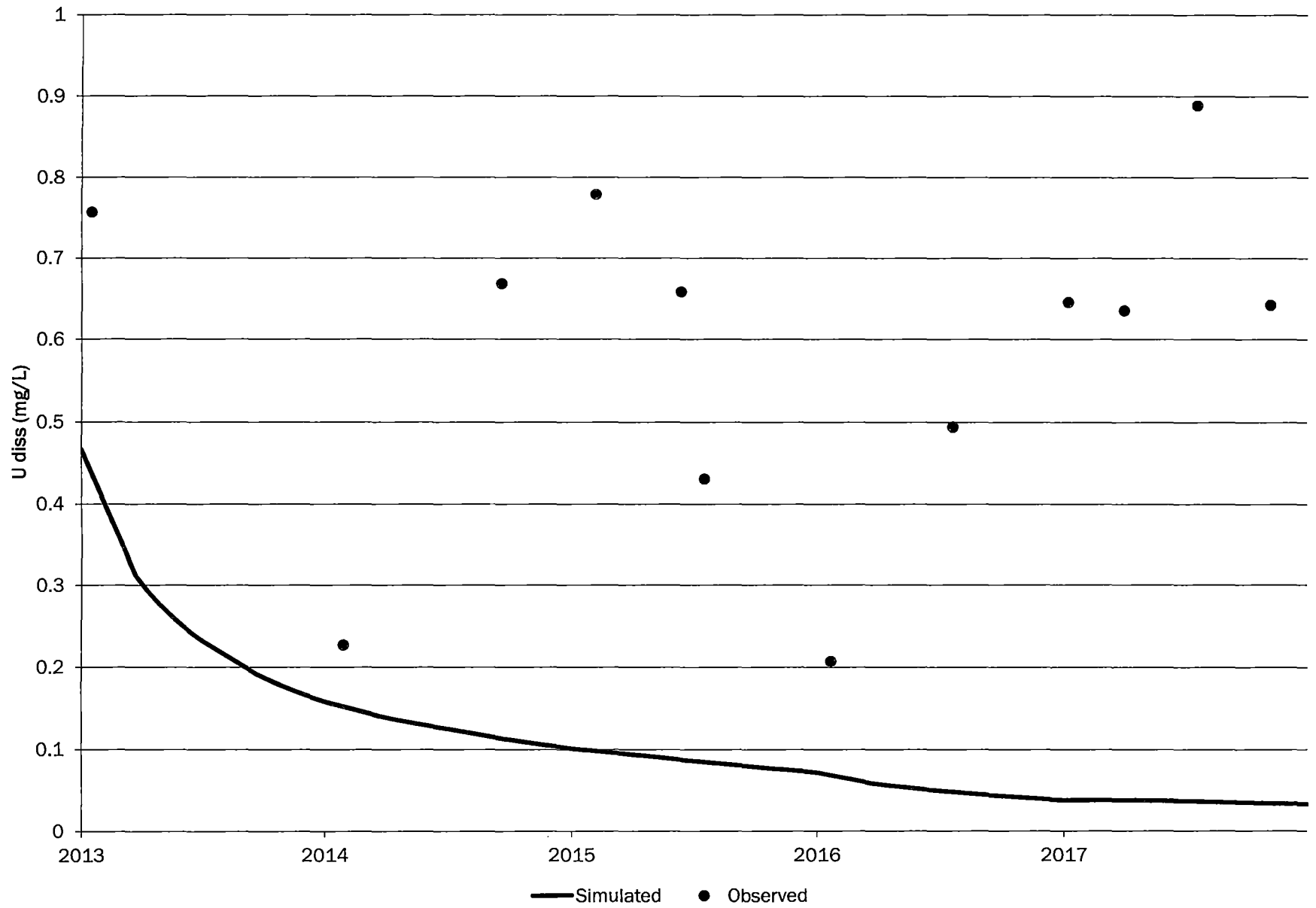
GV-AI



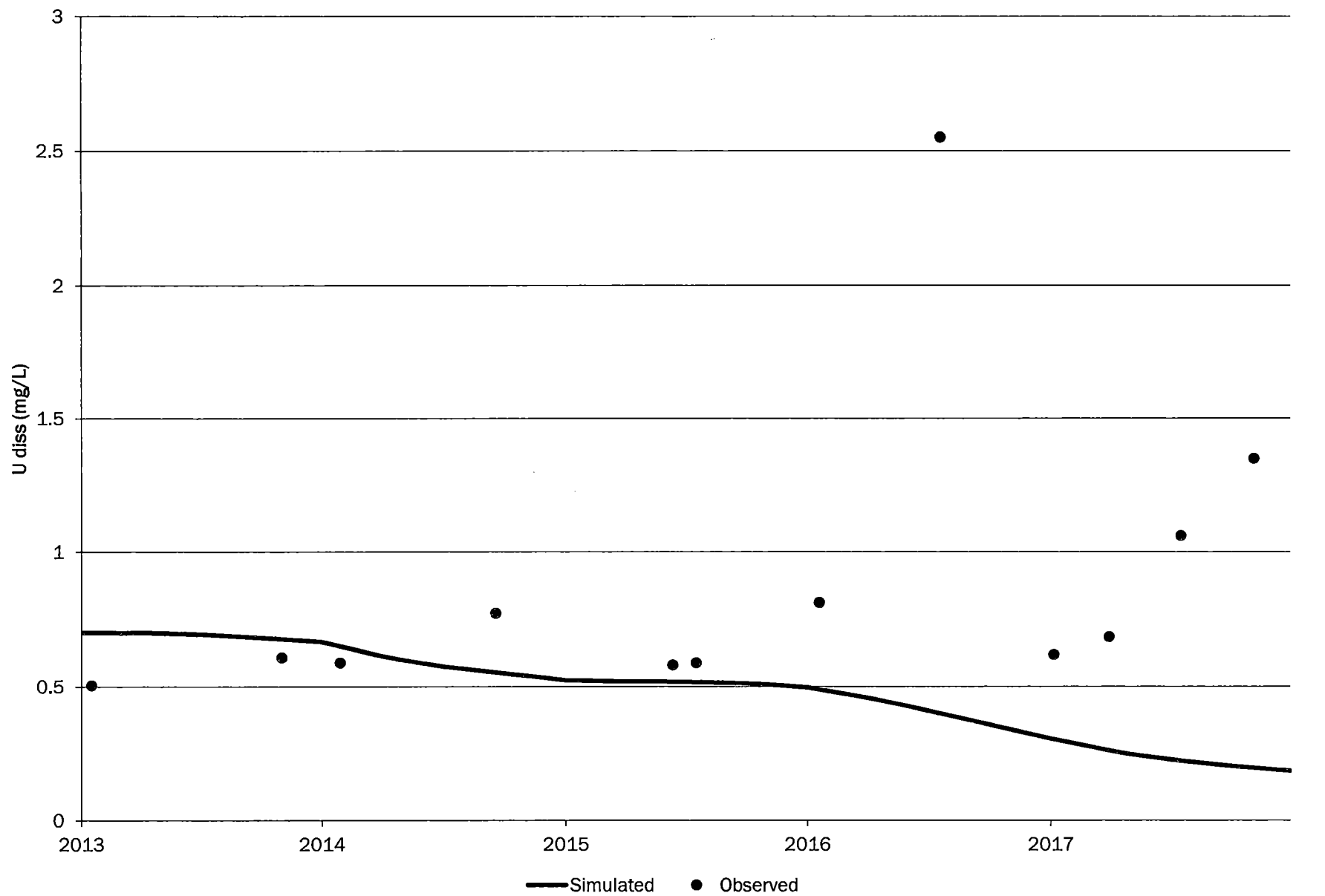
K2-AI



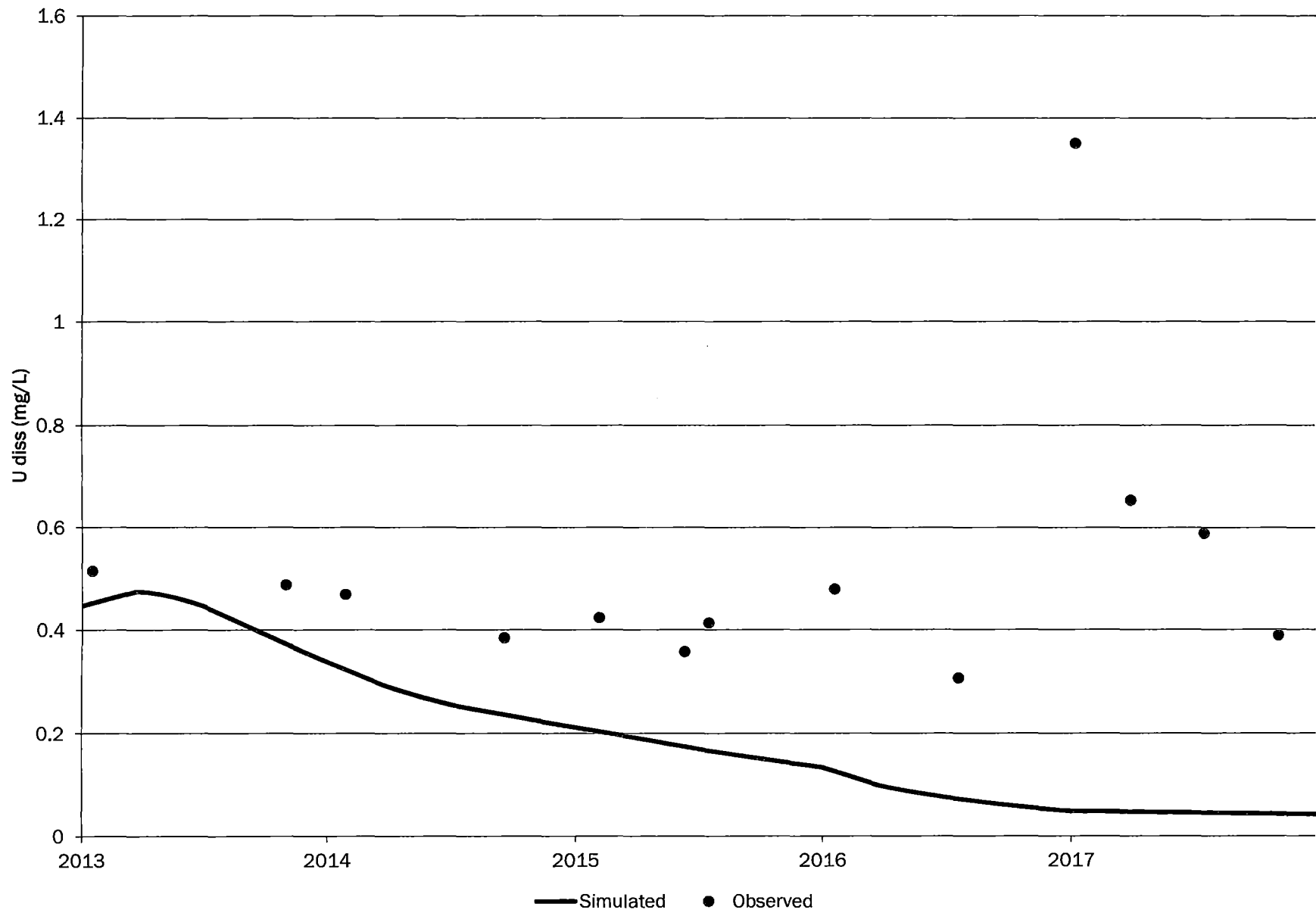
K4-AI



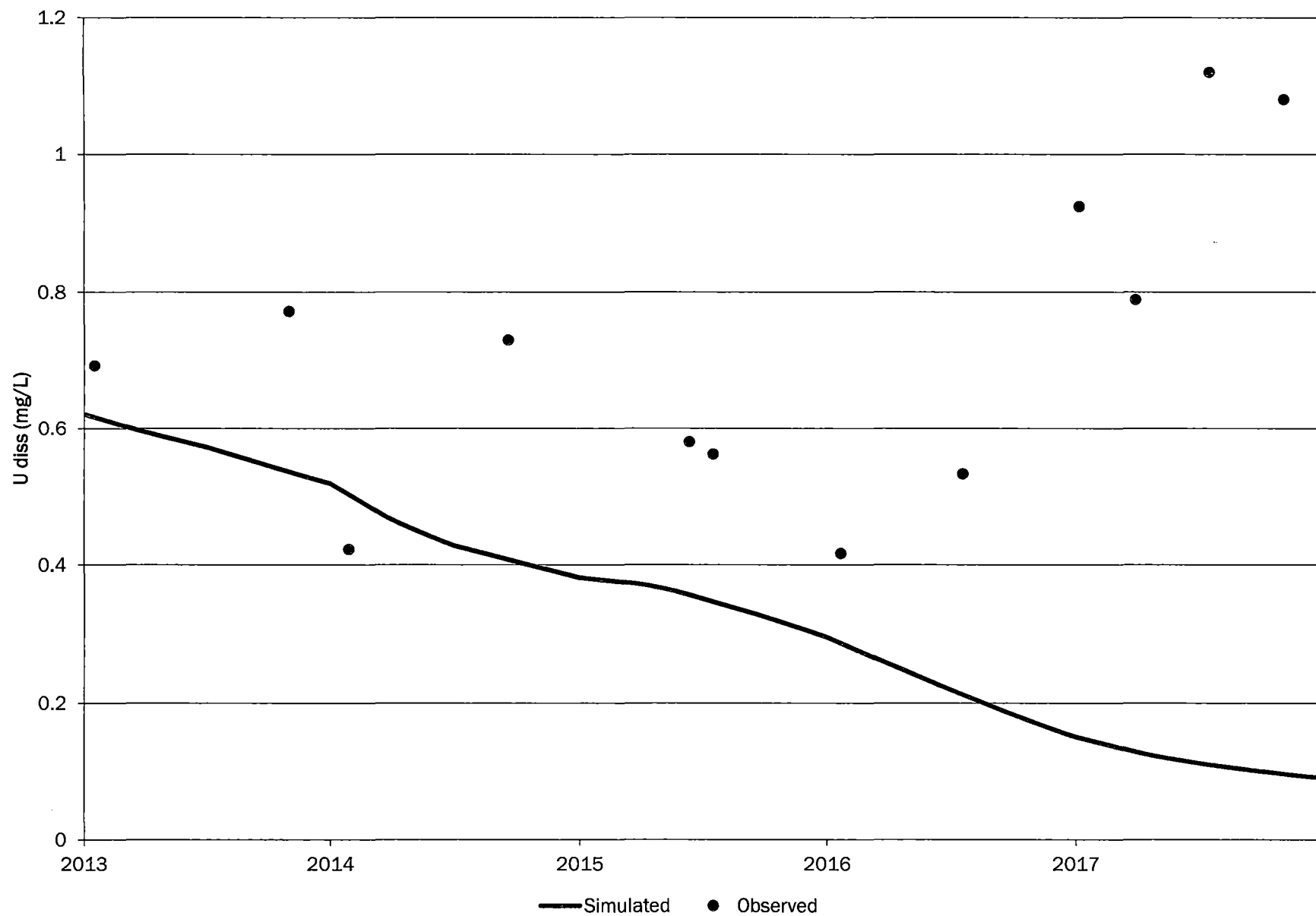
K5-AI



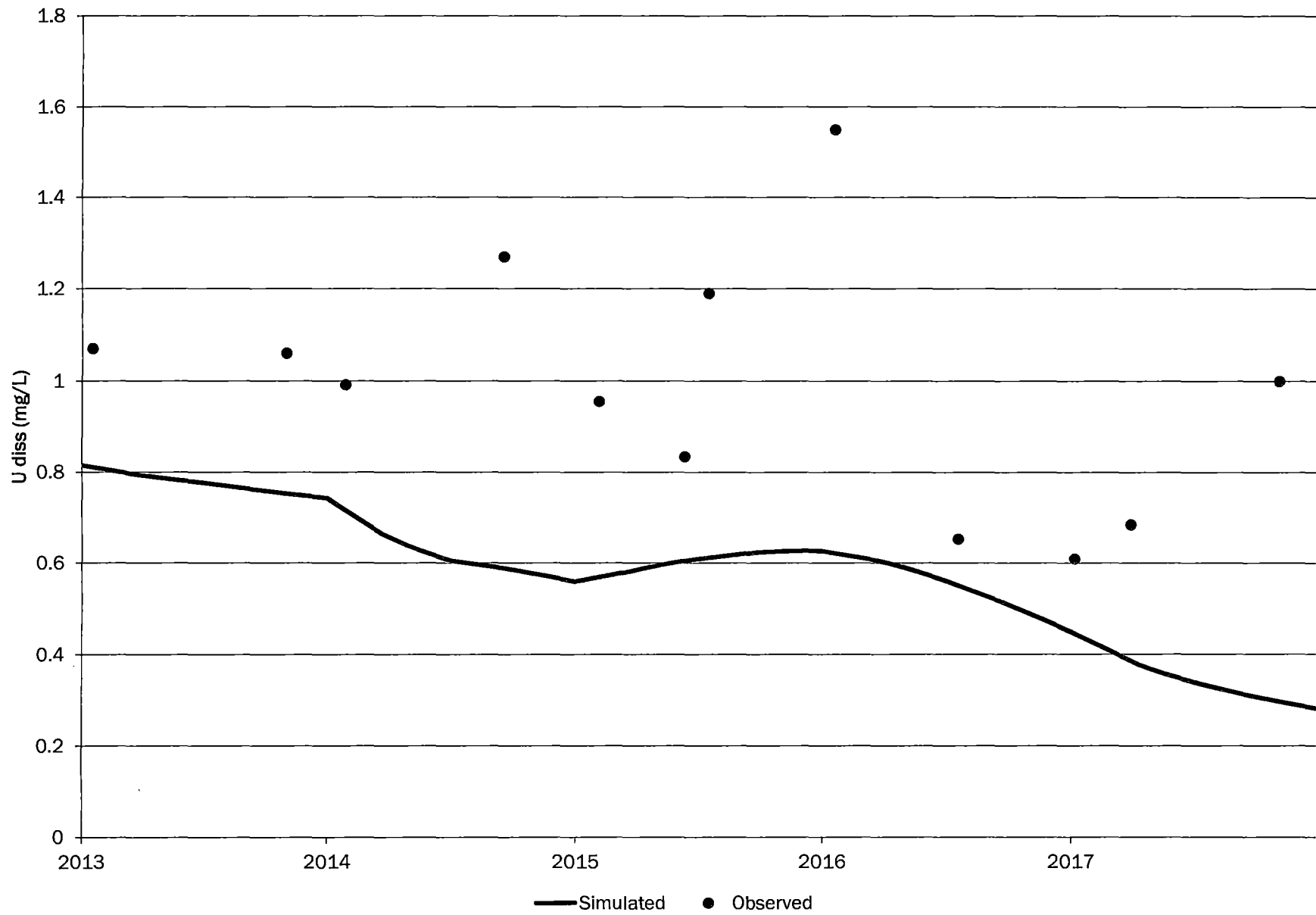
K7-AI



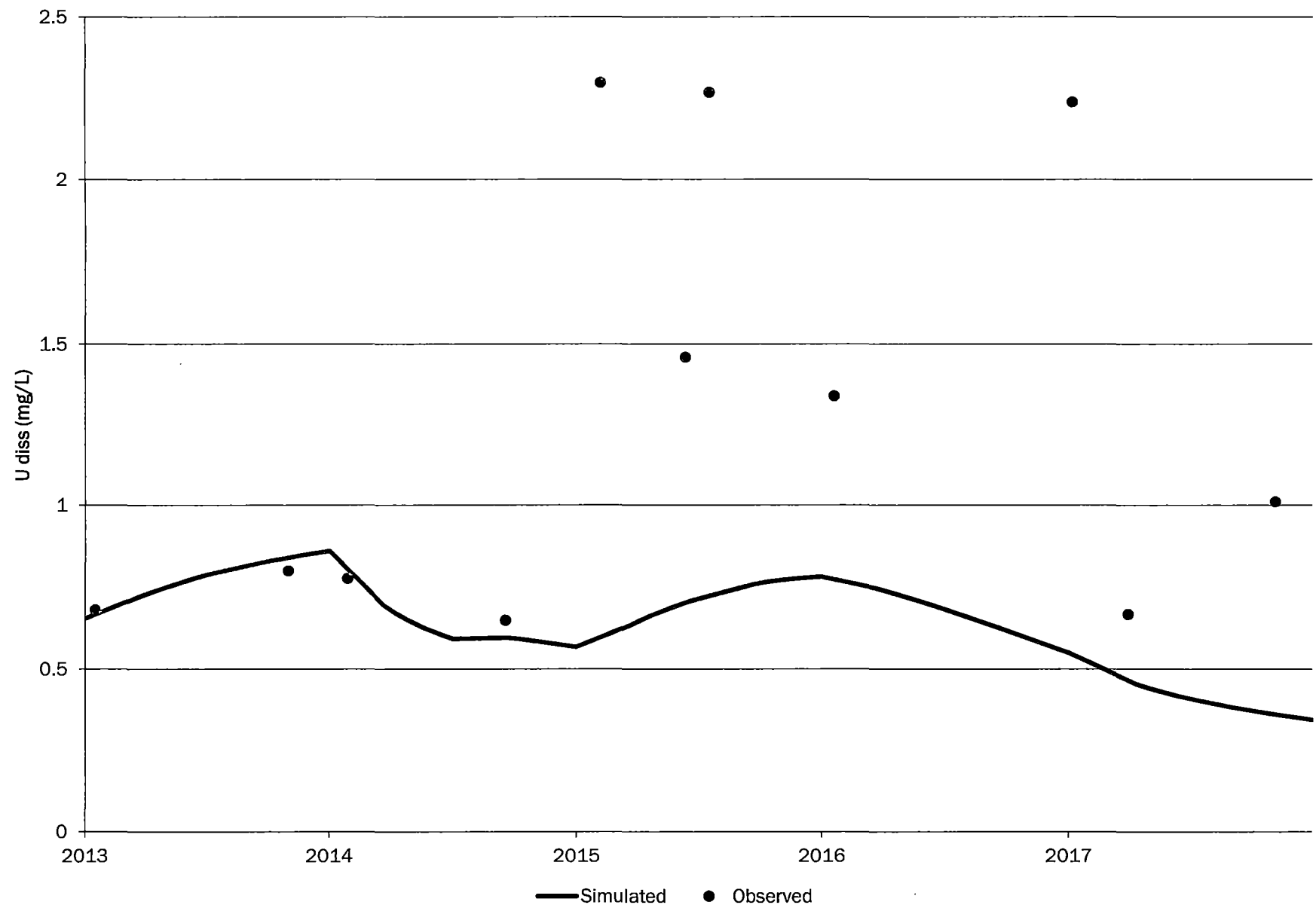
K8-AI



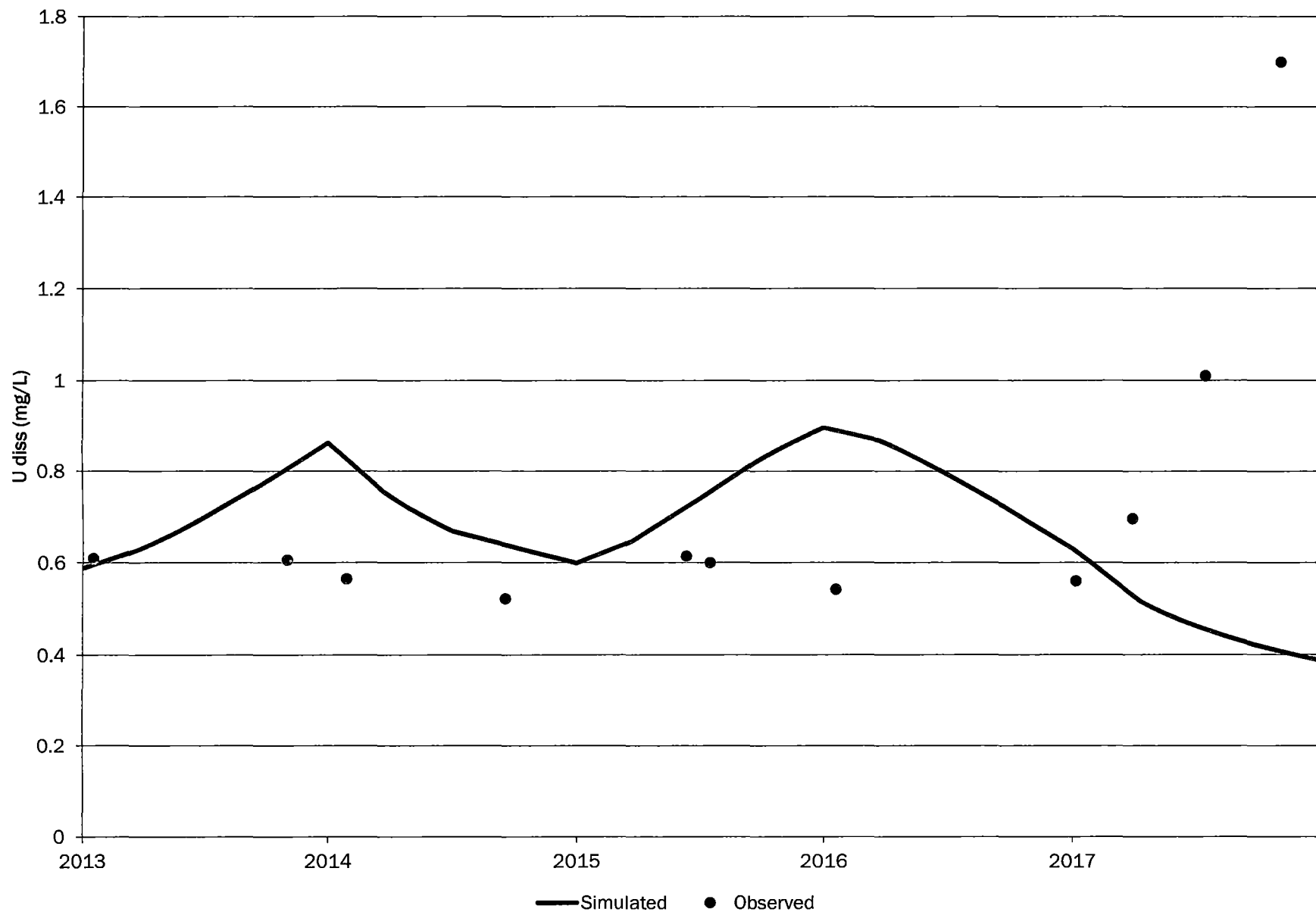
K9-AI



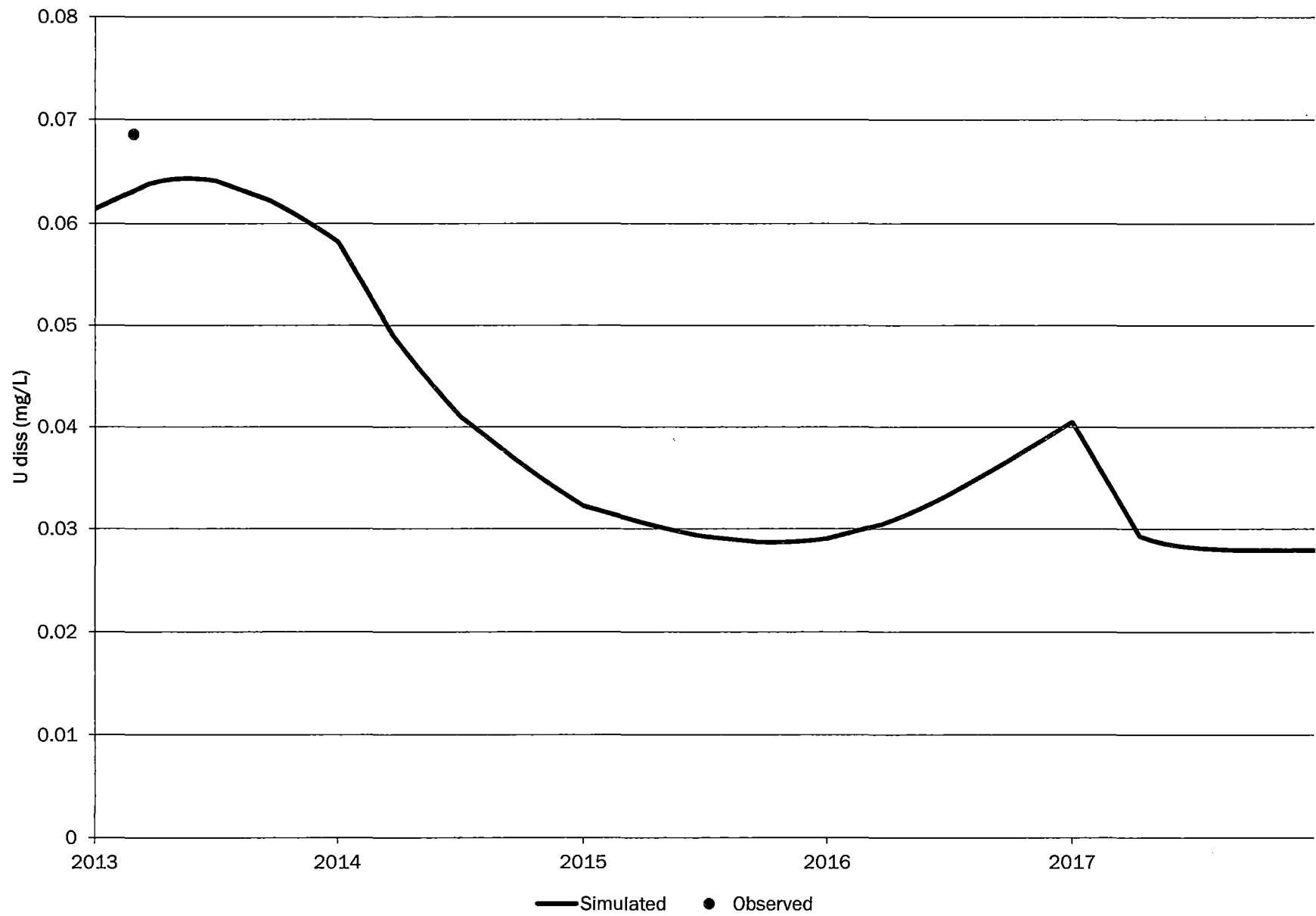
K10-AI



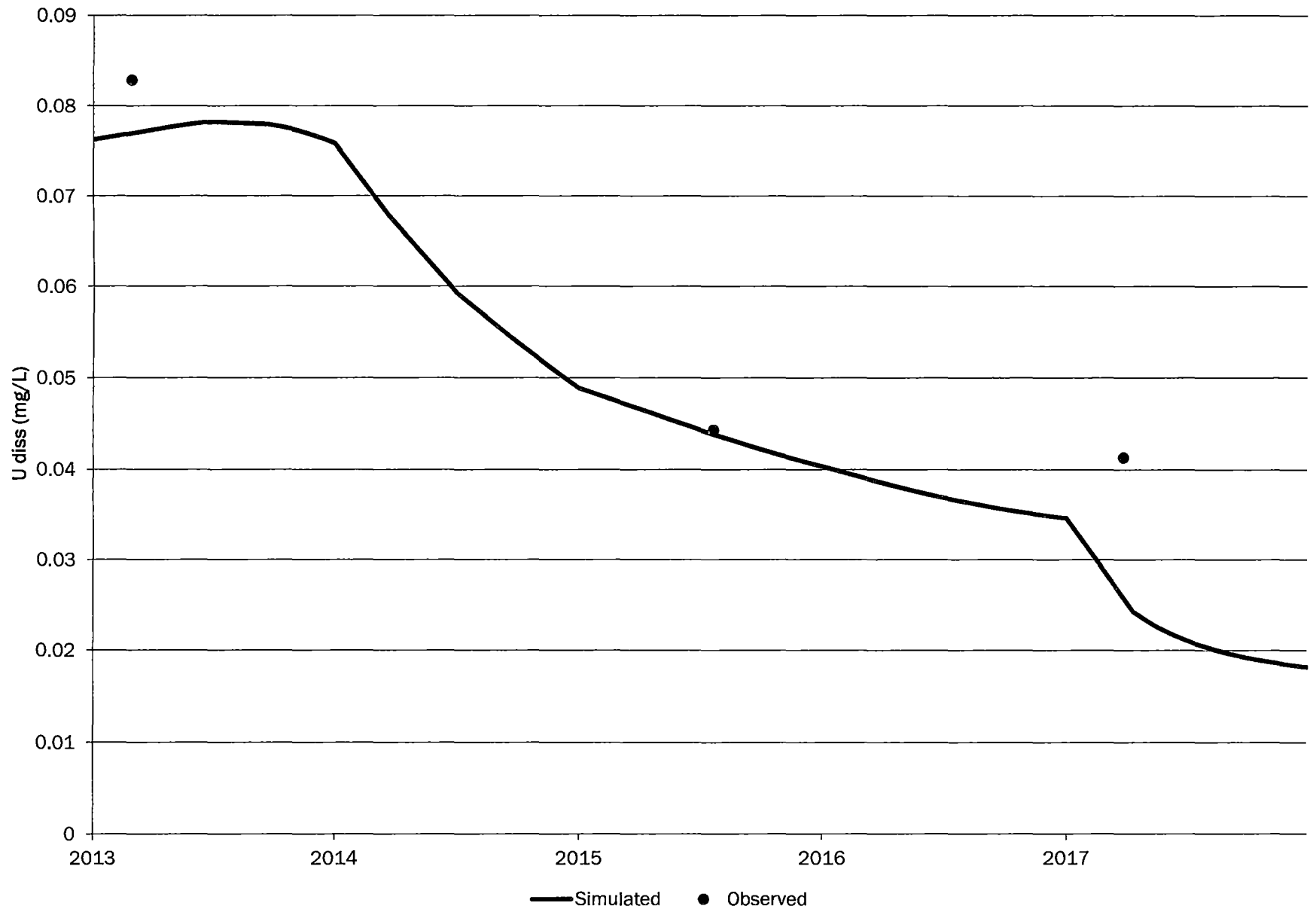
K11-AI



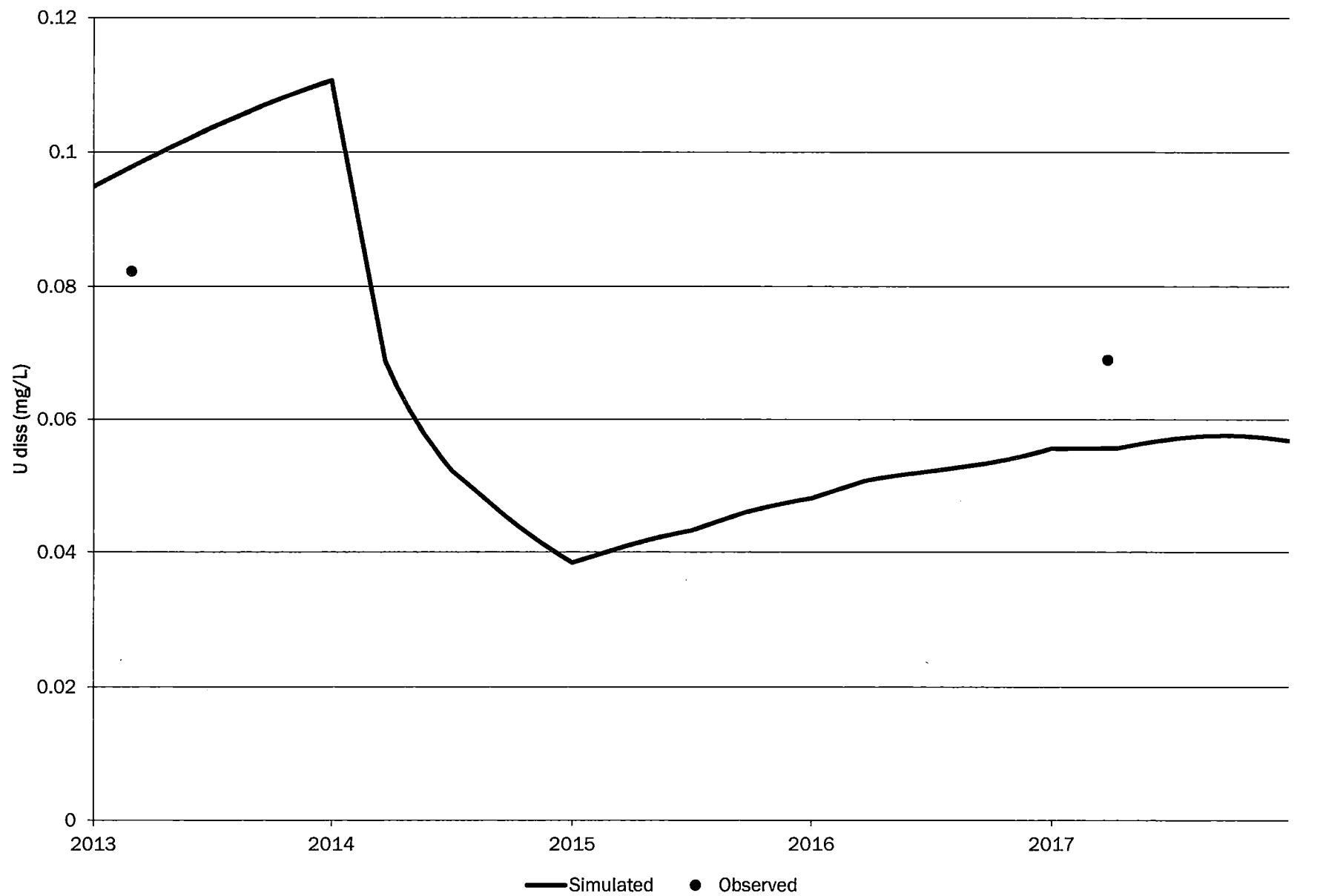
KEB-AI



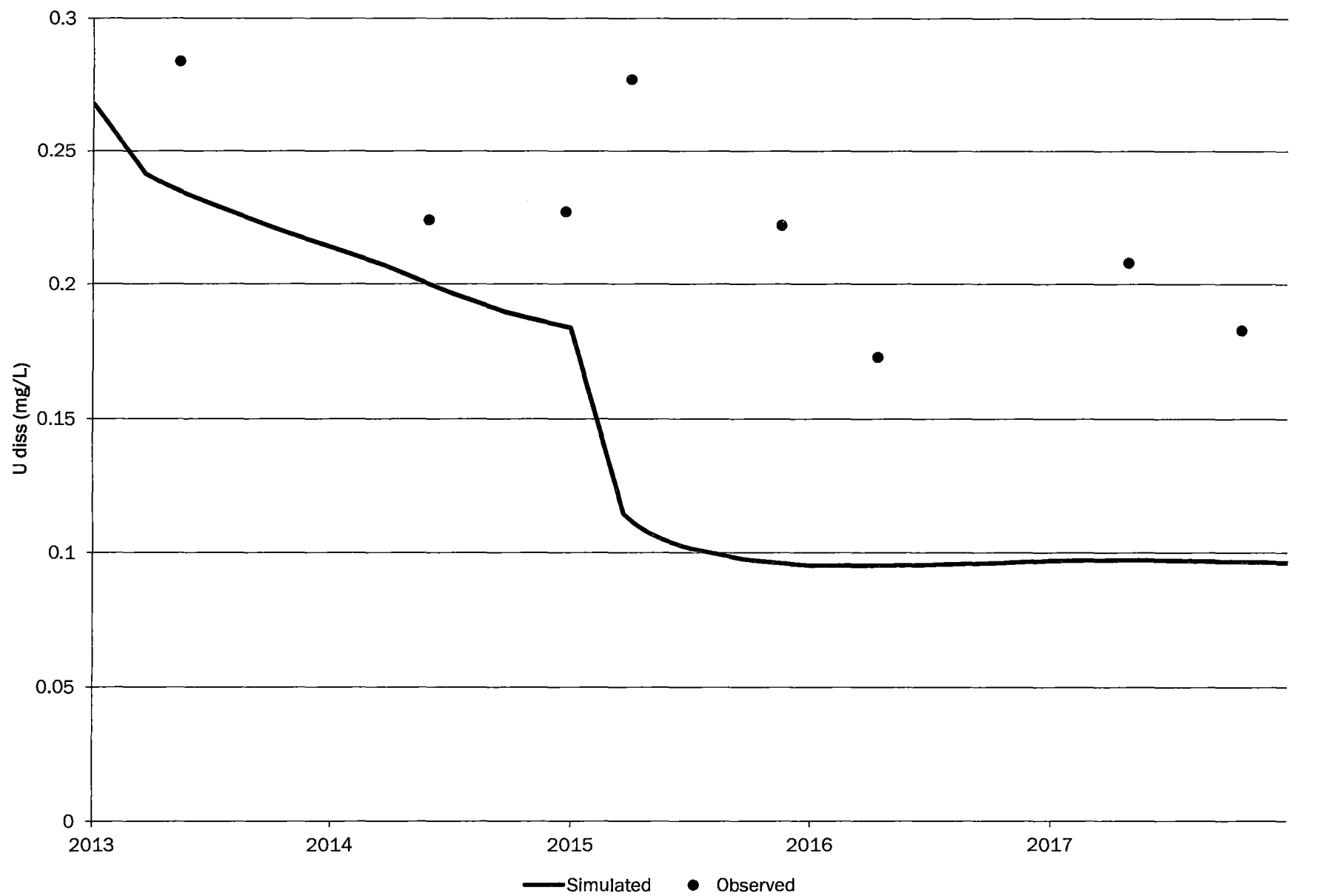
KF-AI



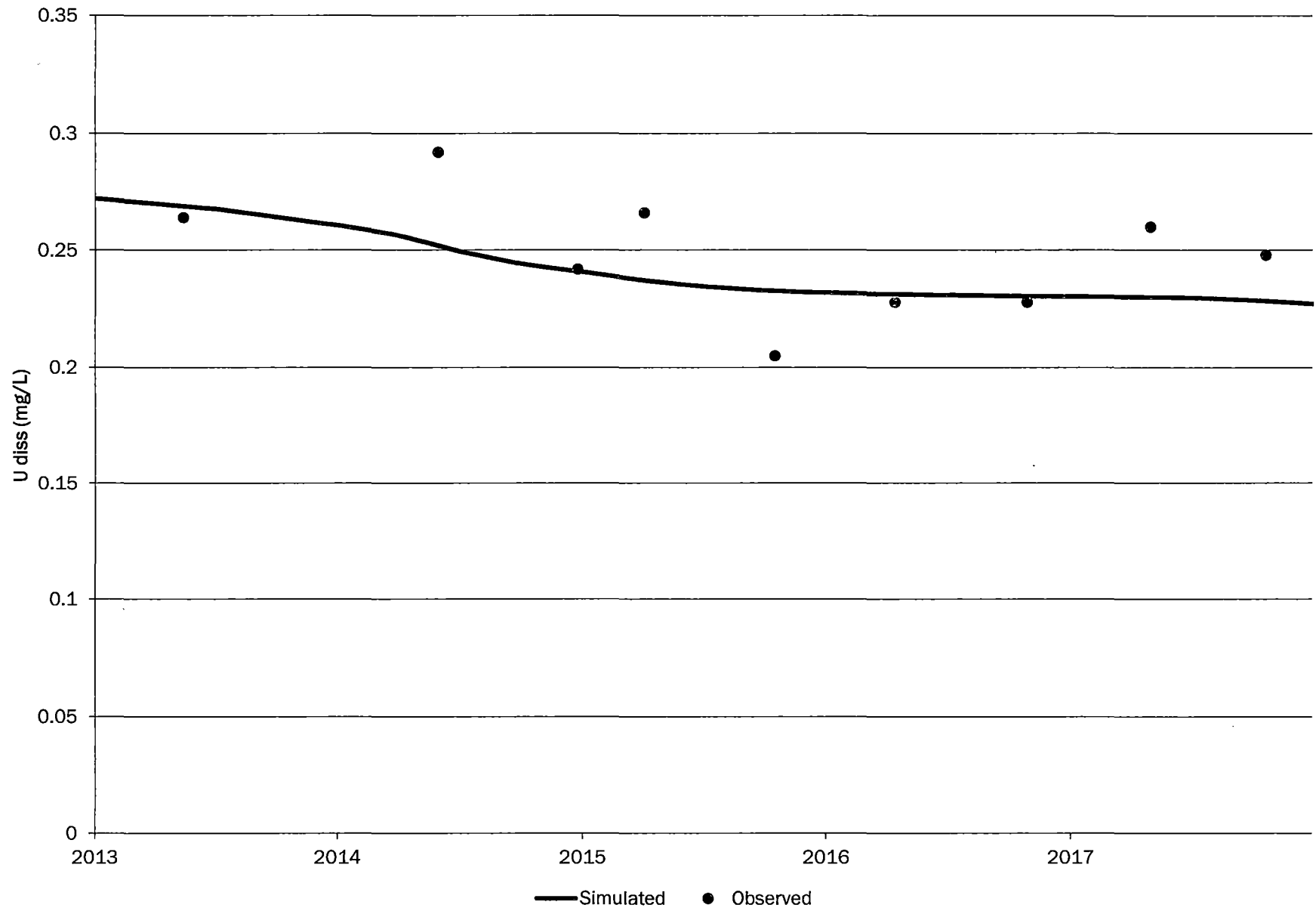
KZ-AI



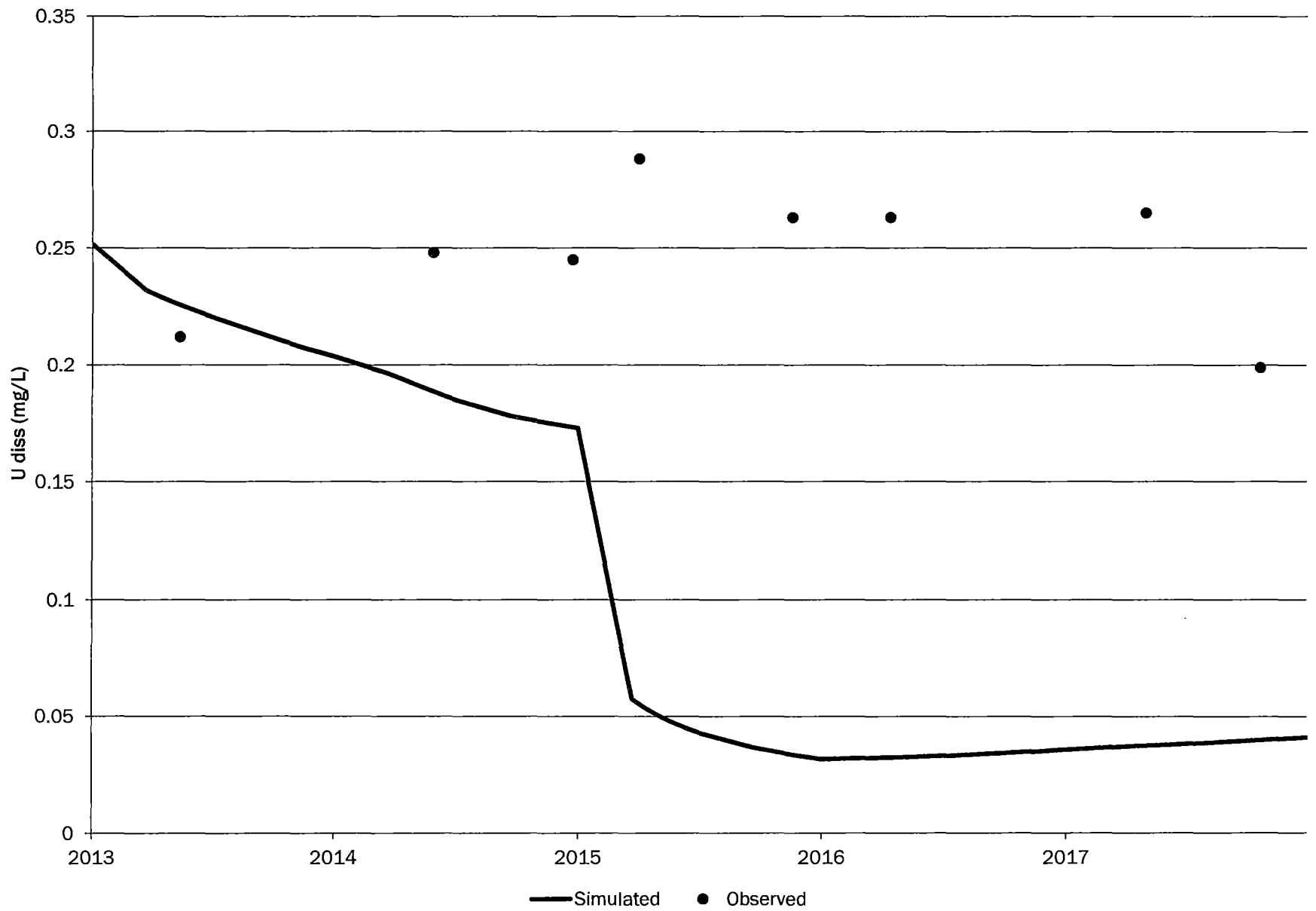
L5-AI



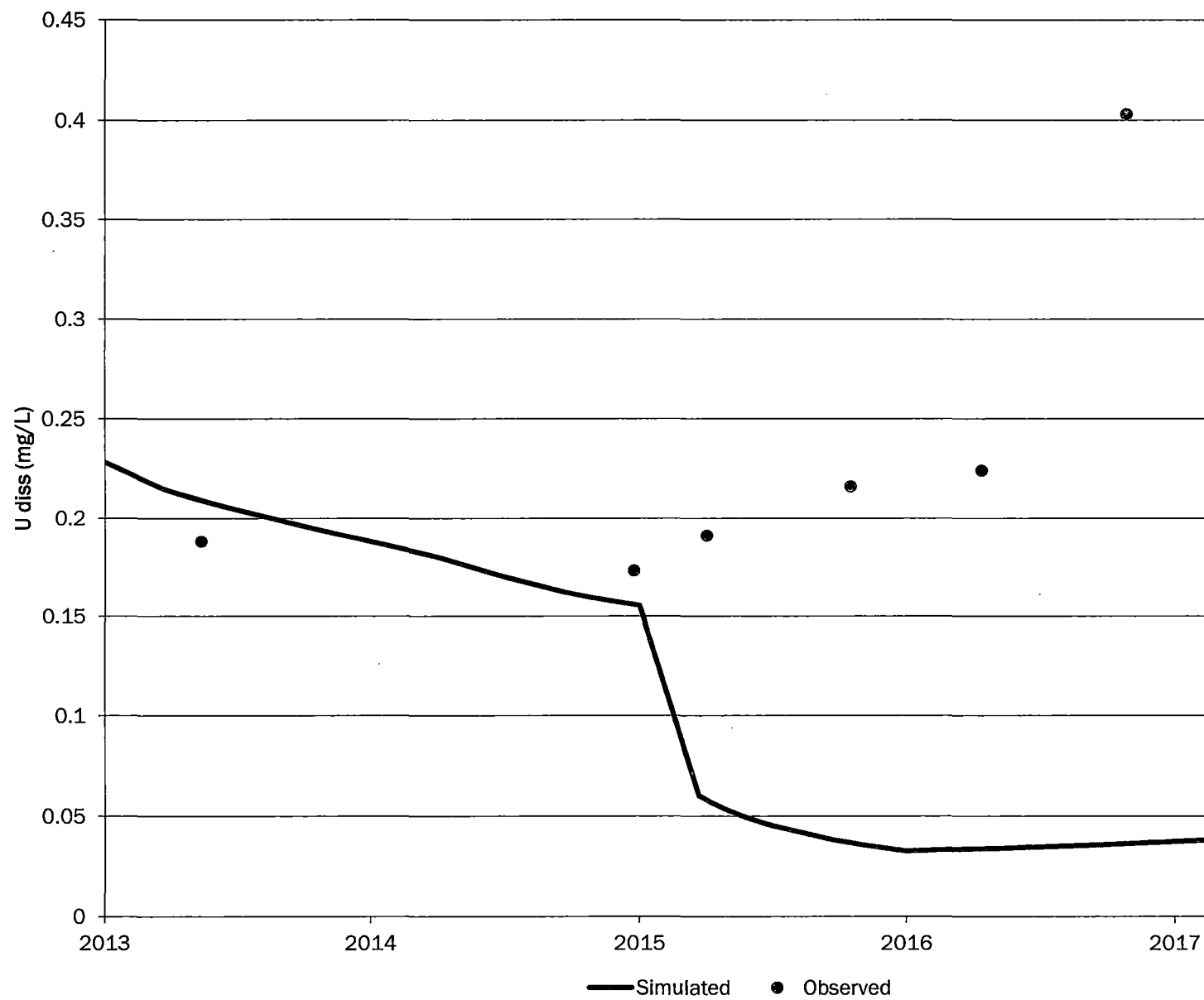
L6-AI



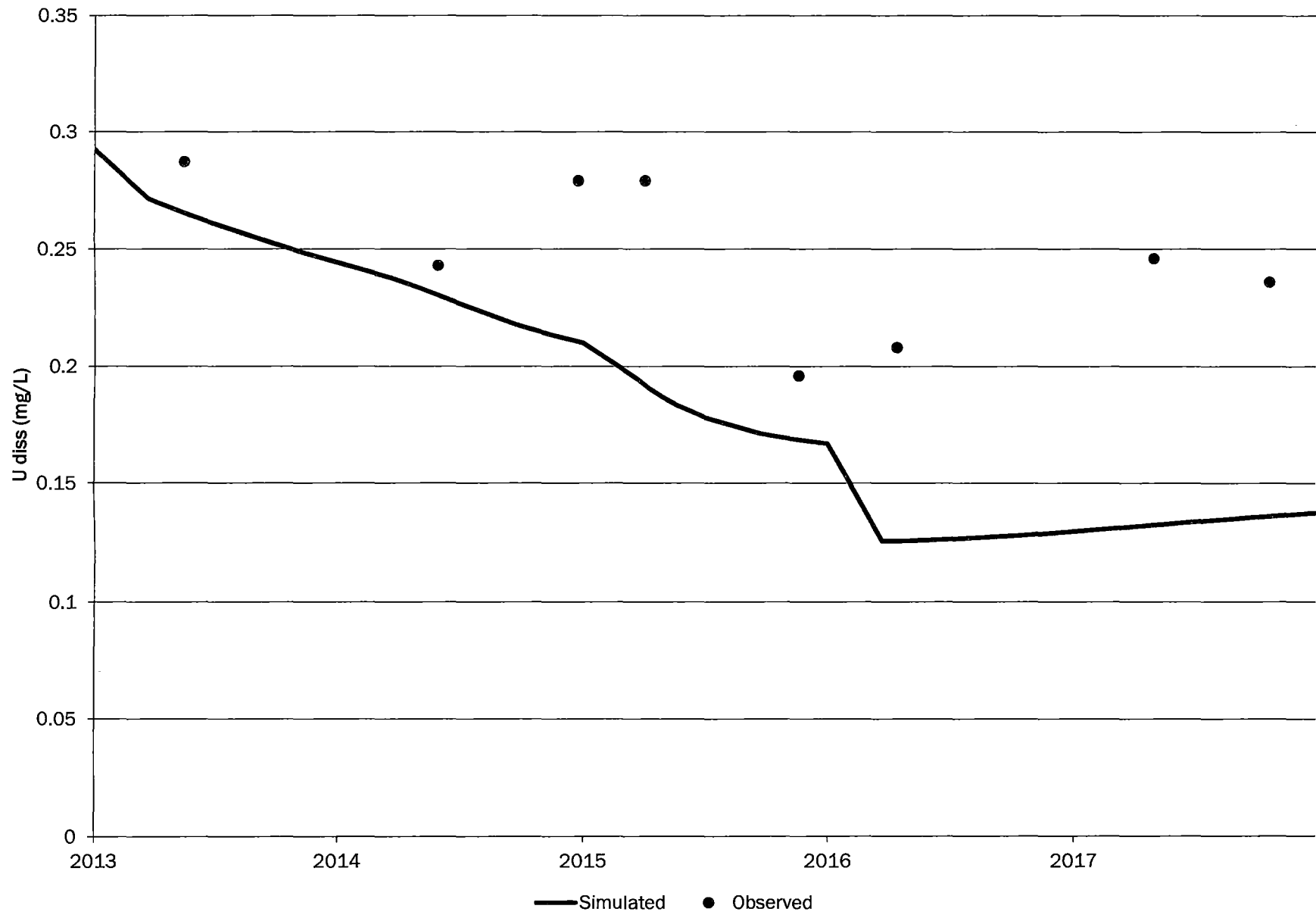
L7-AI



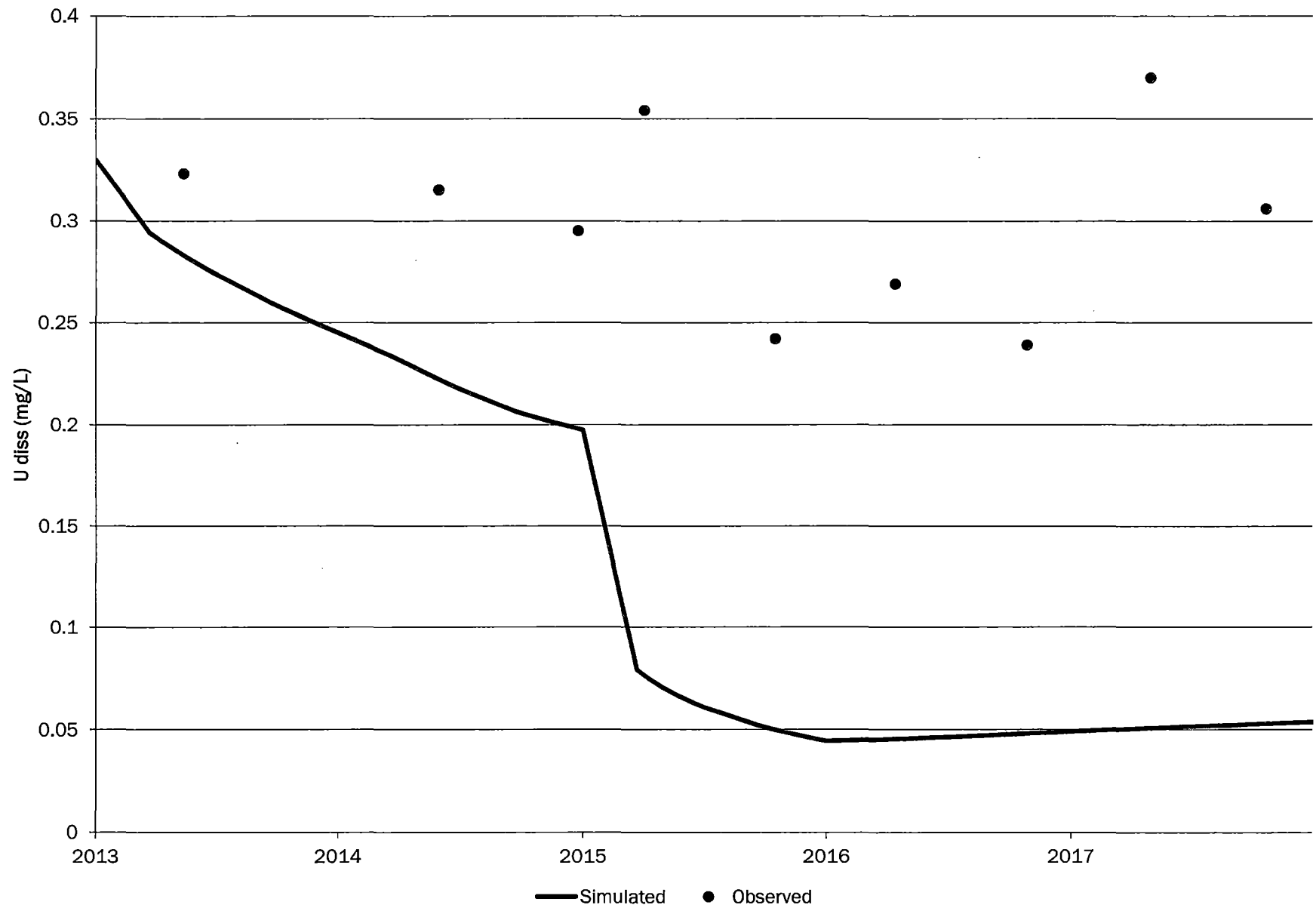
L8-AI



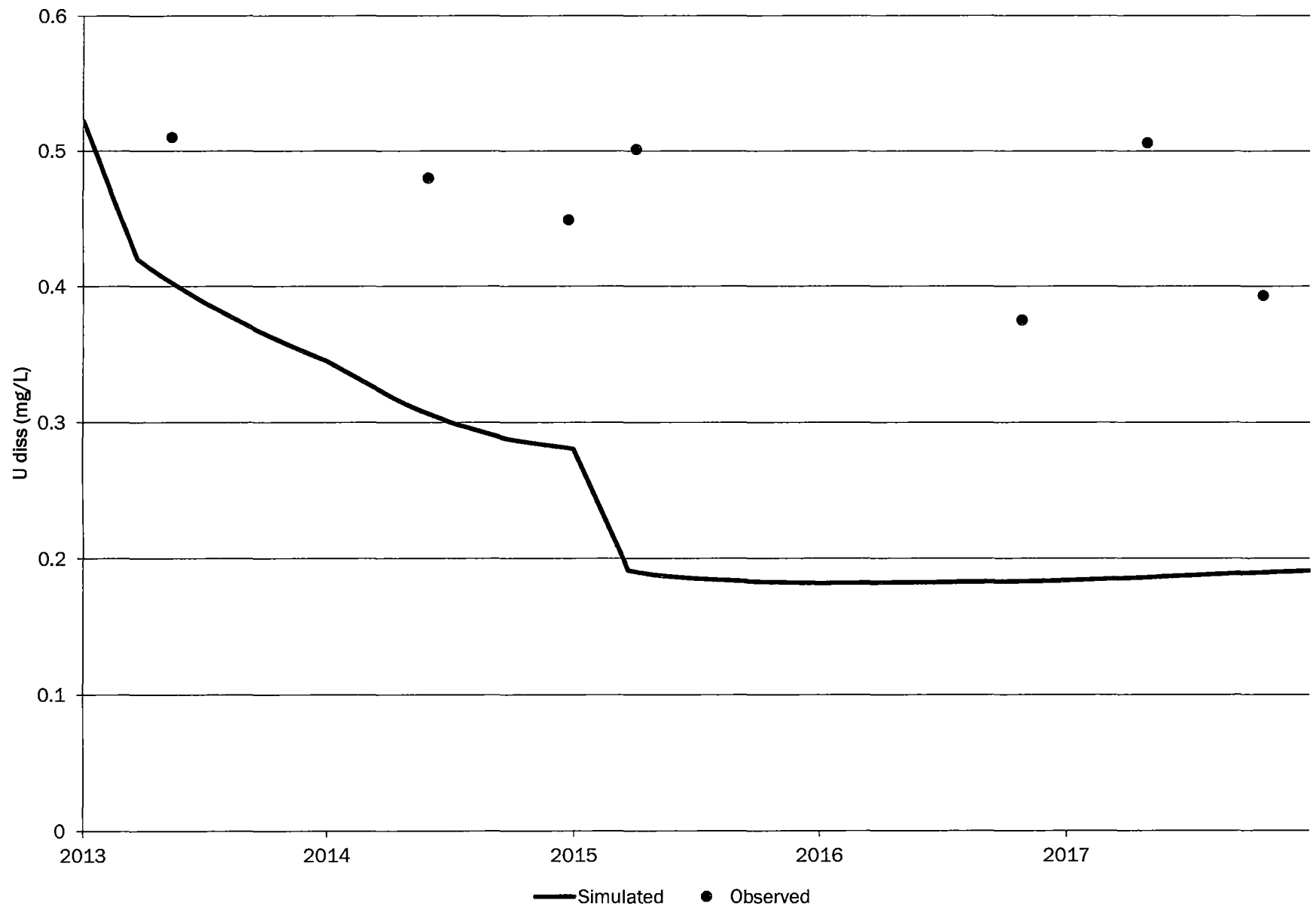
L9-AI



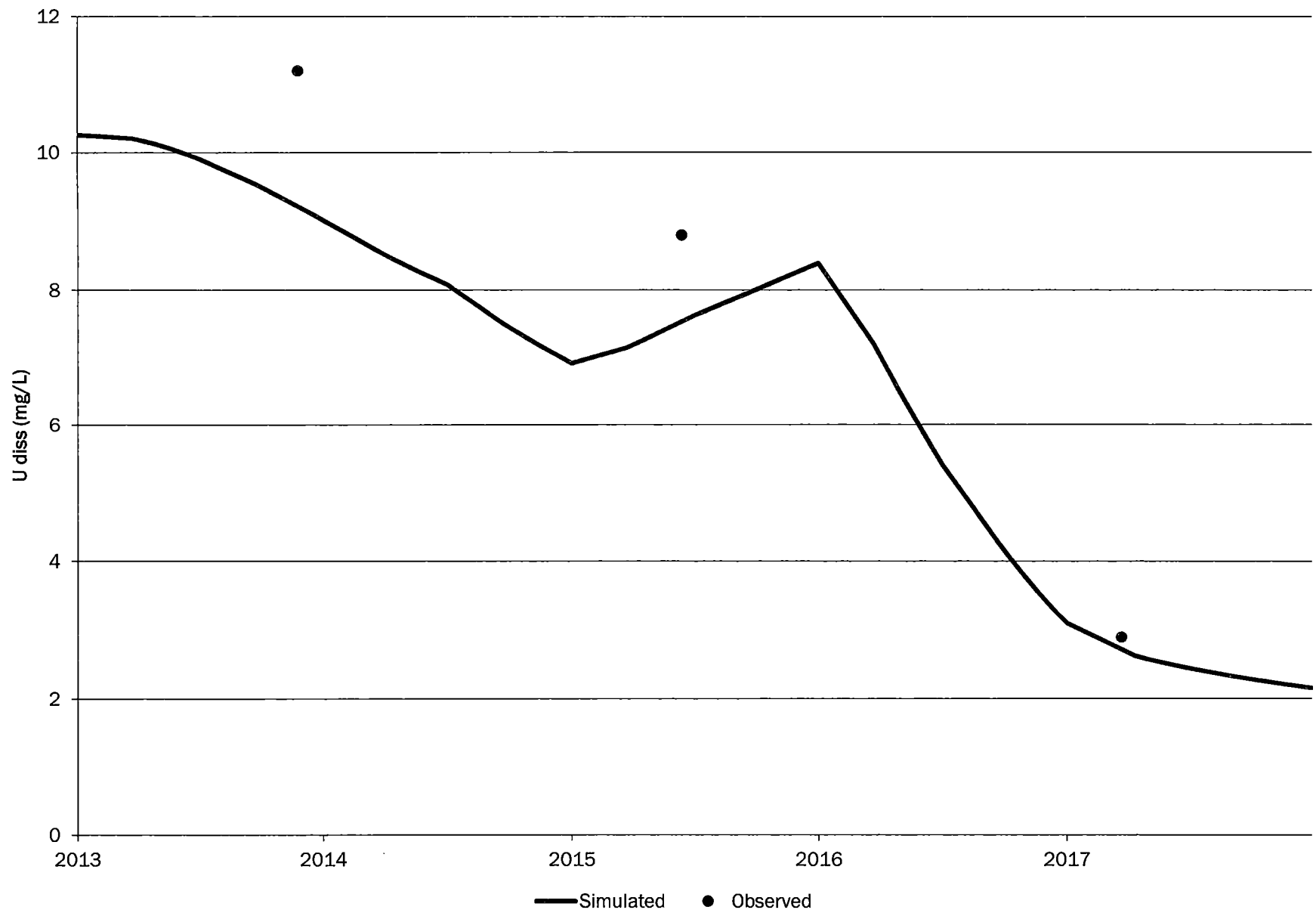
L10-AI



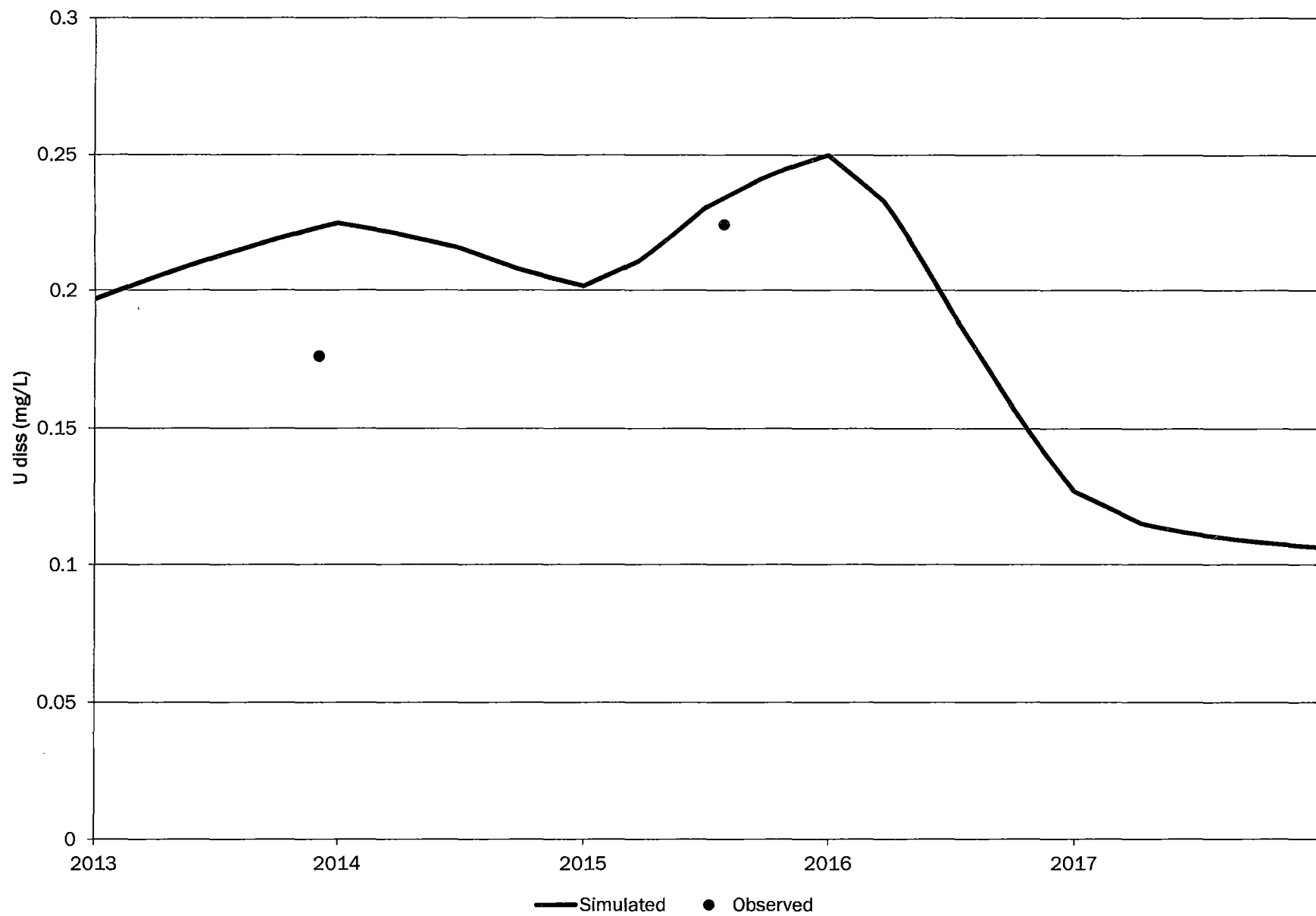
L-AI



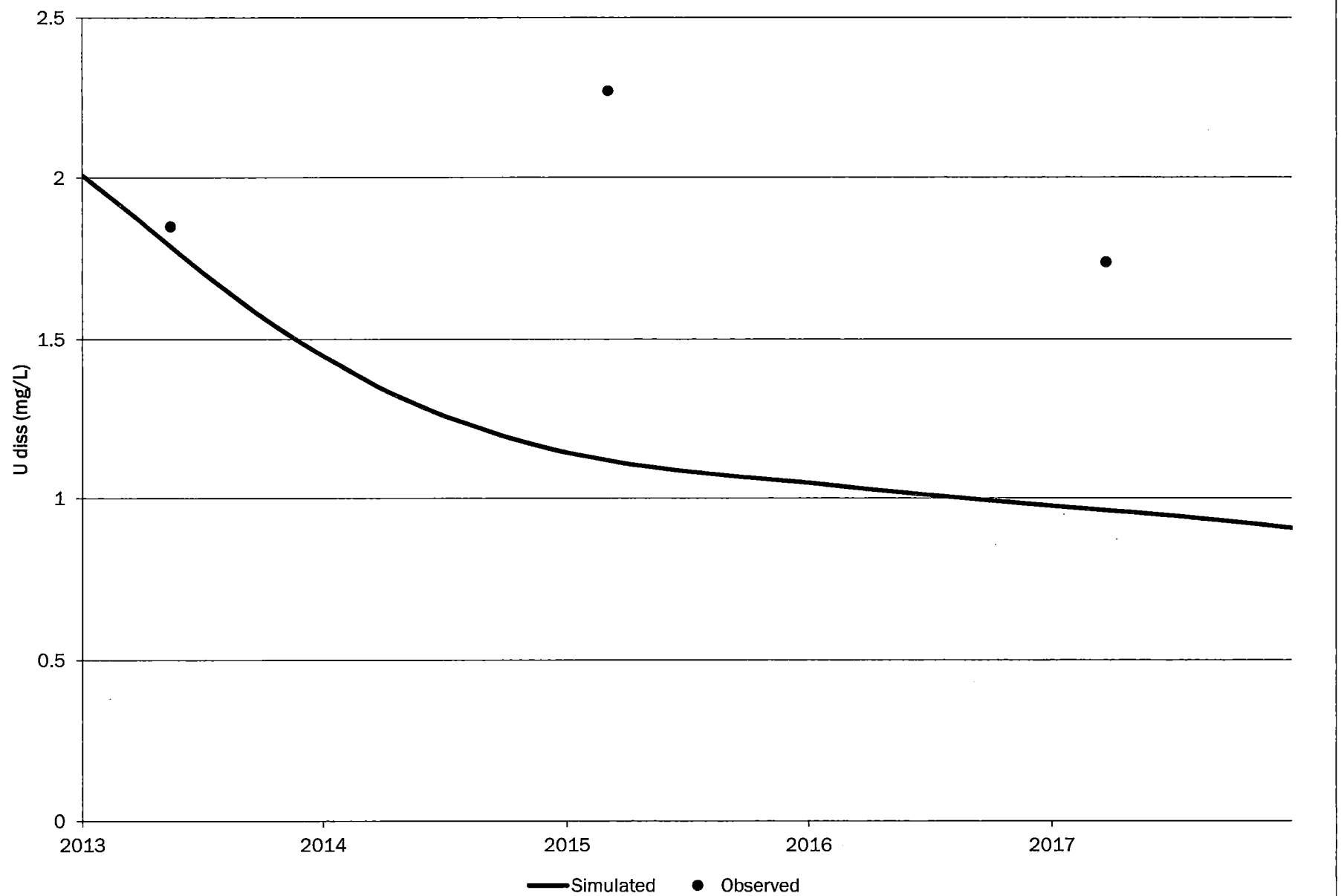
M3-AI



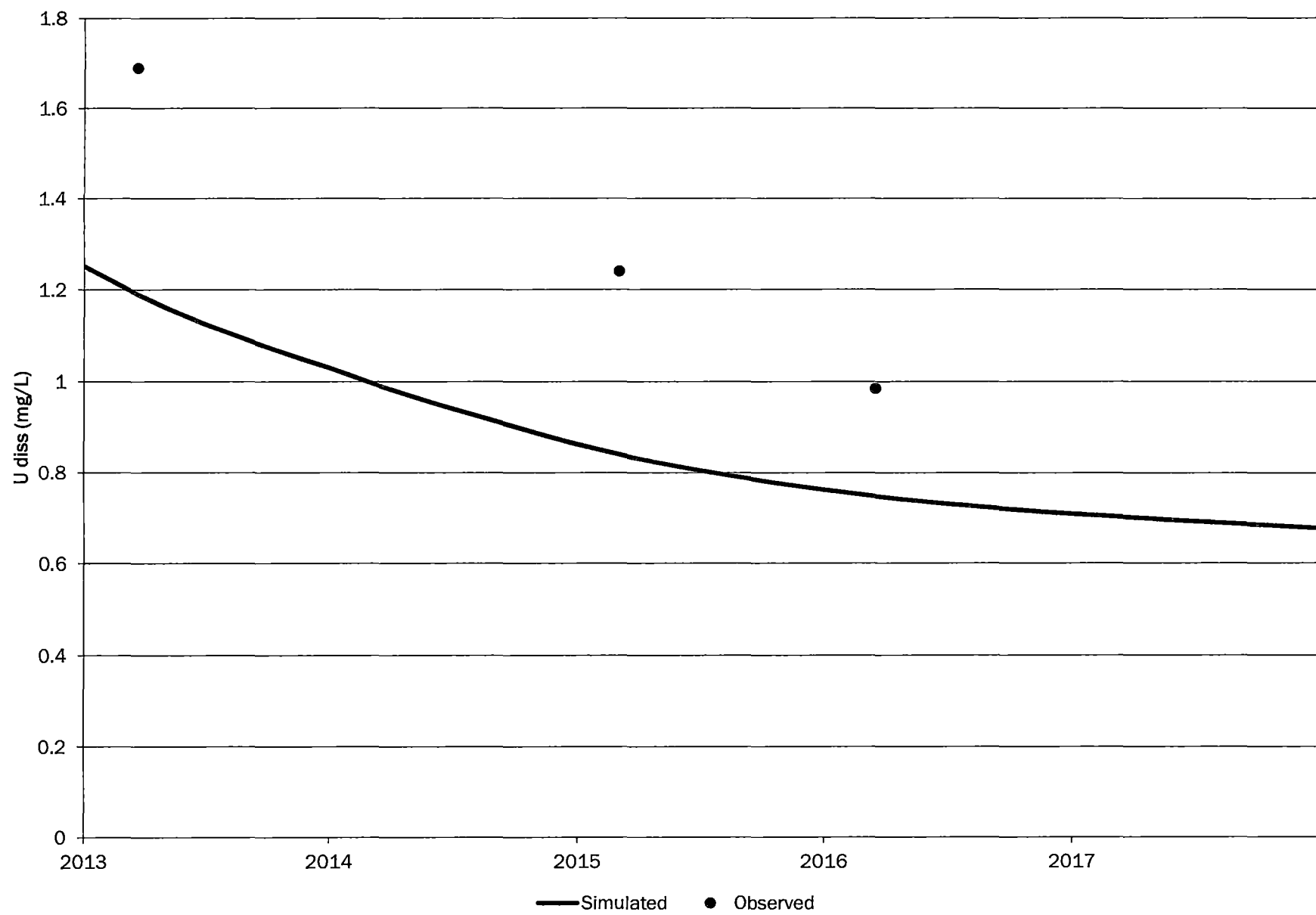
M5-AI



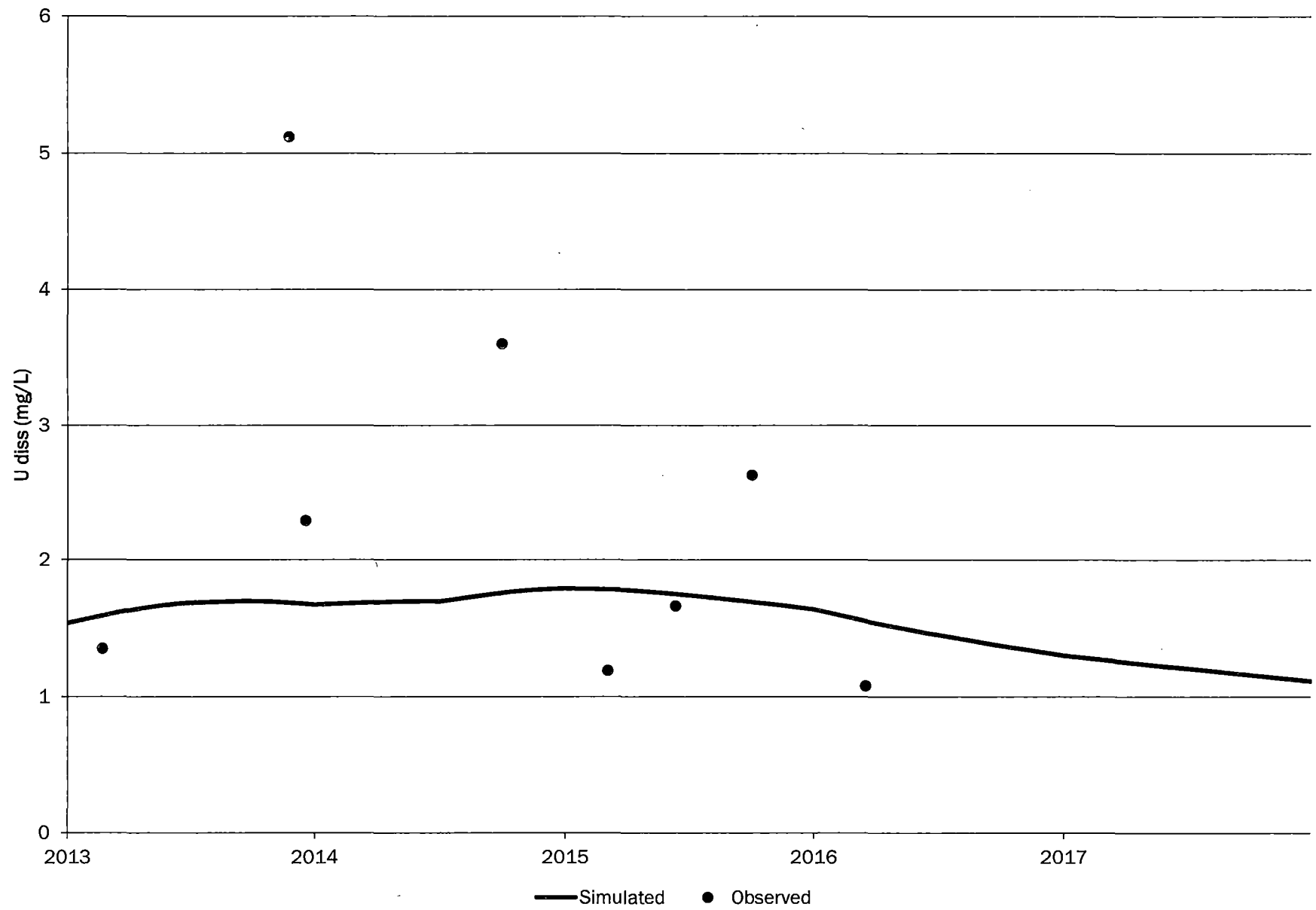
M6-AI



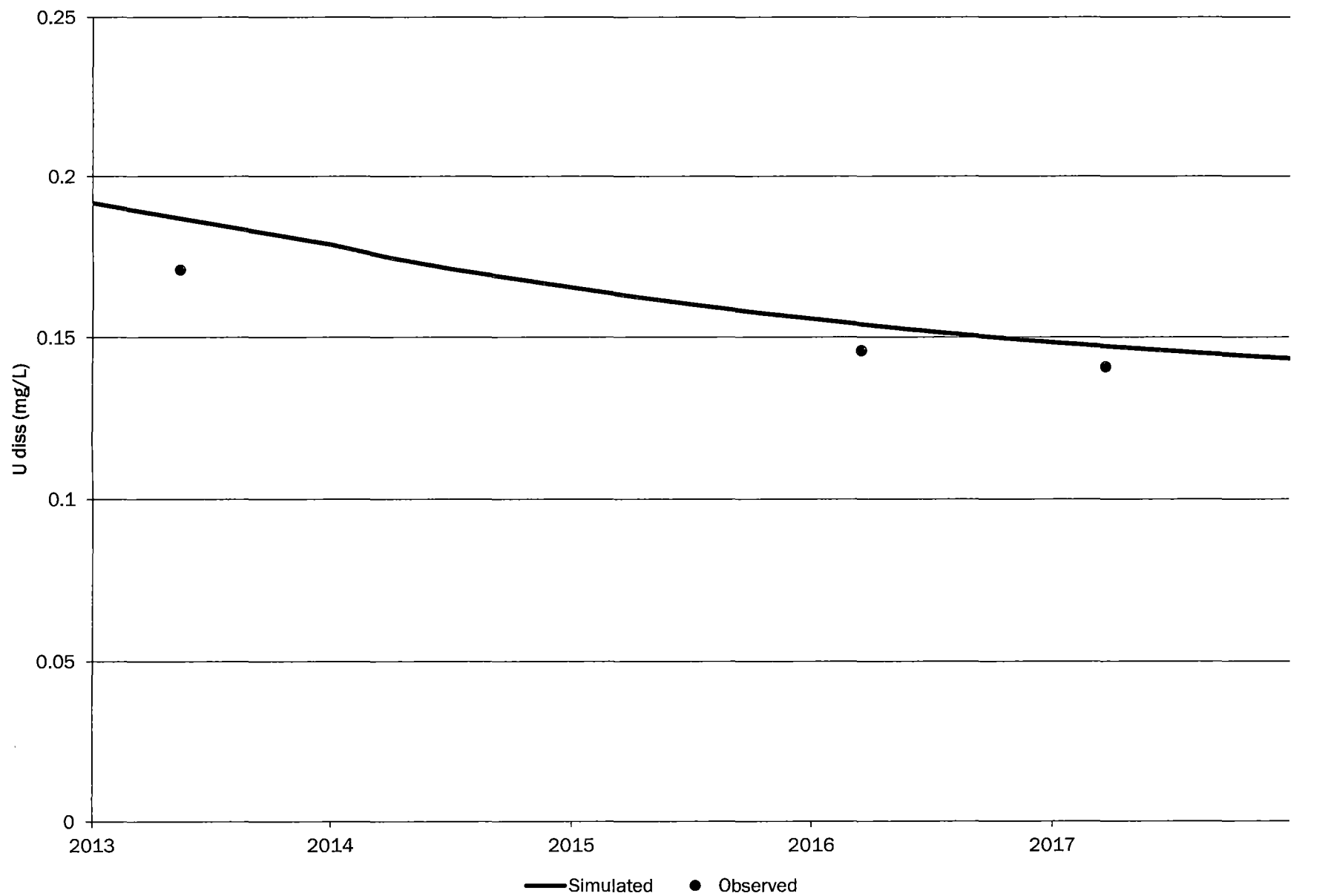
M7-AI



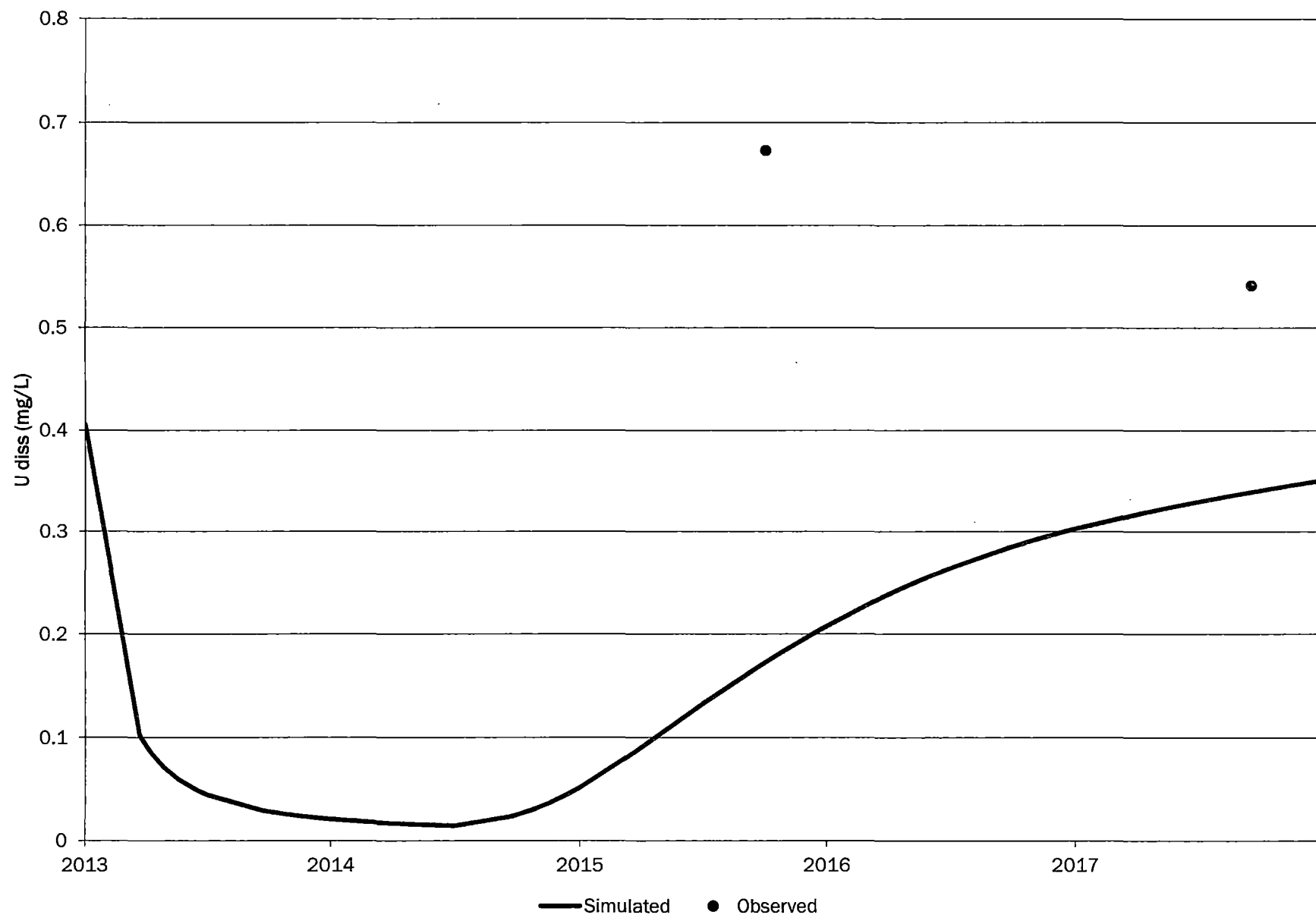
M9-AI



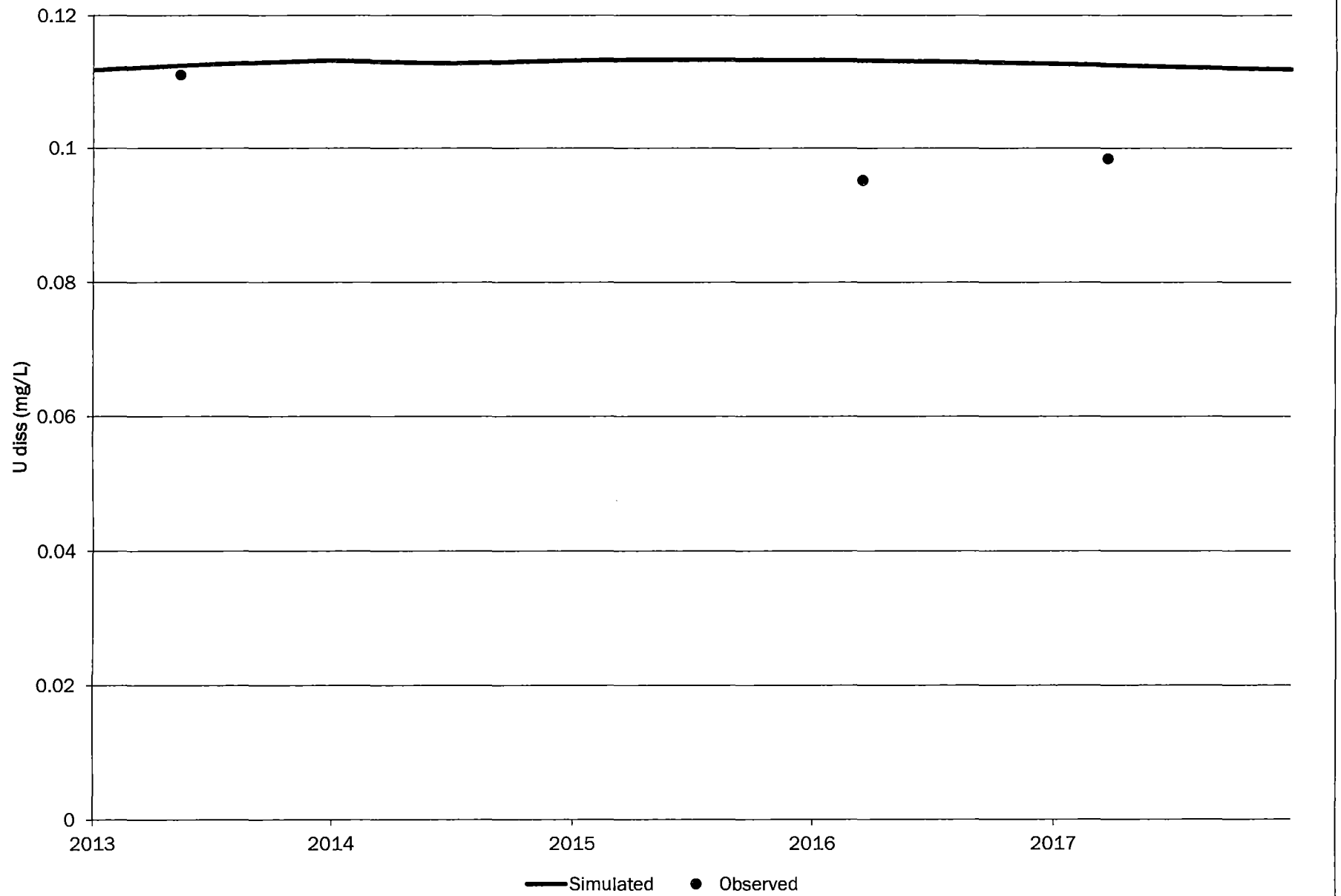
M10-AI



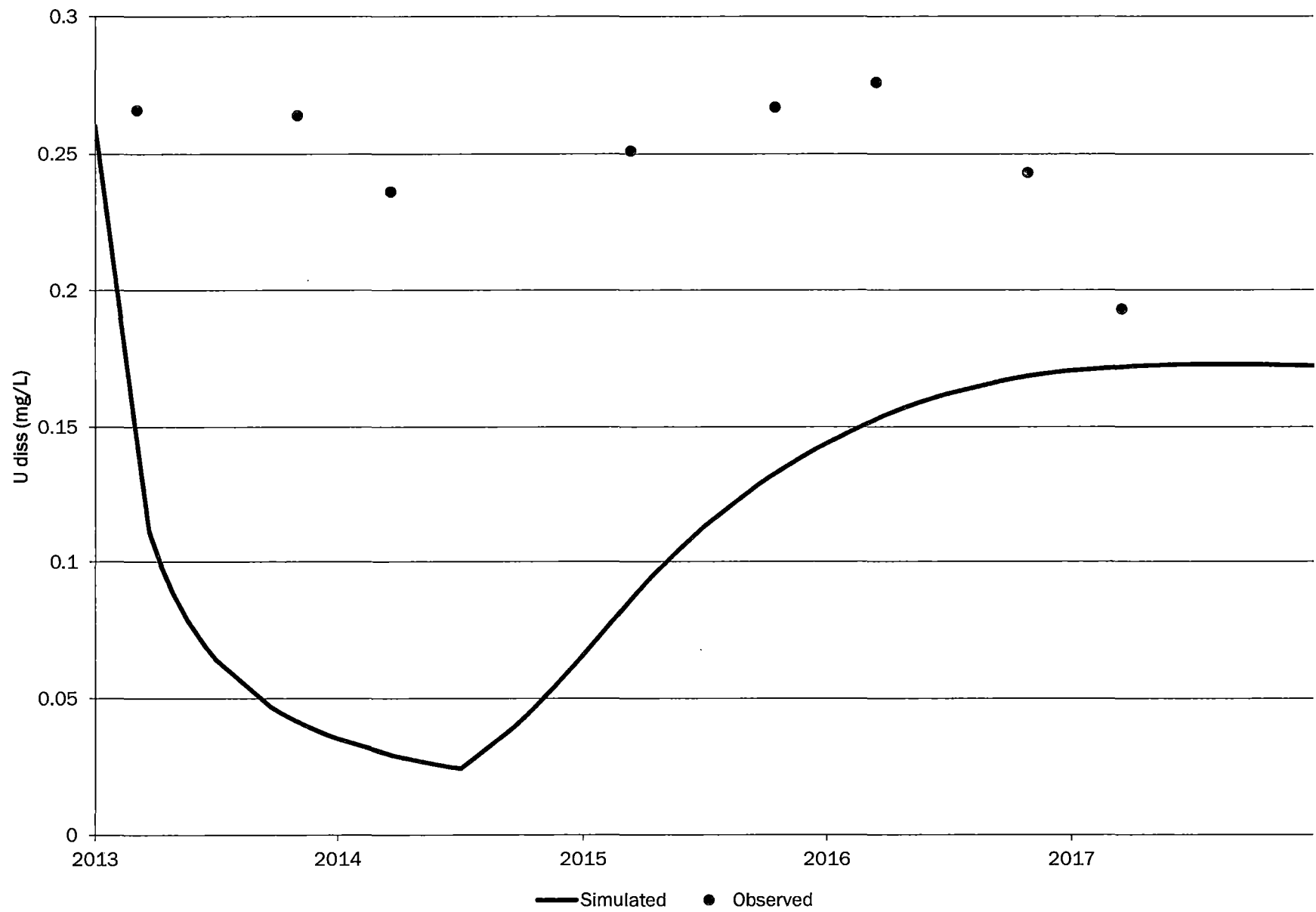
M16-AI



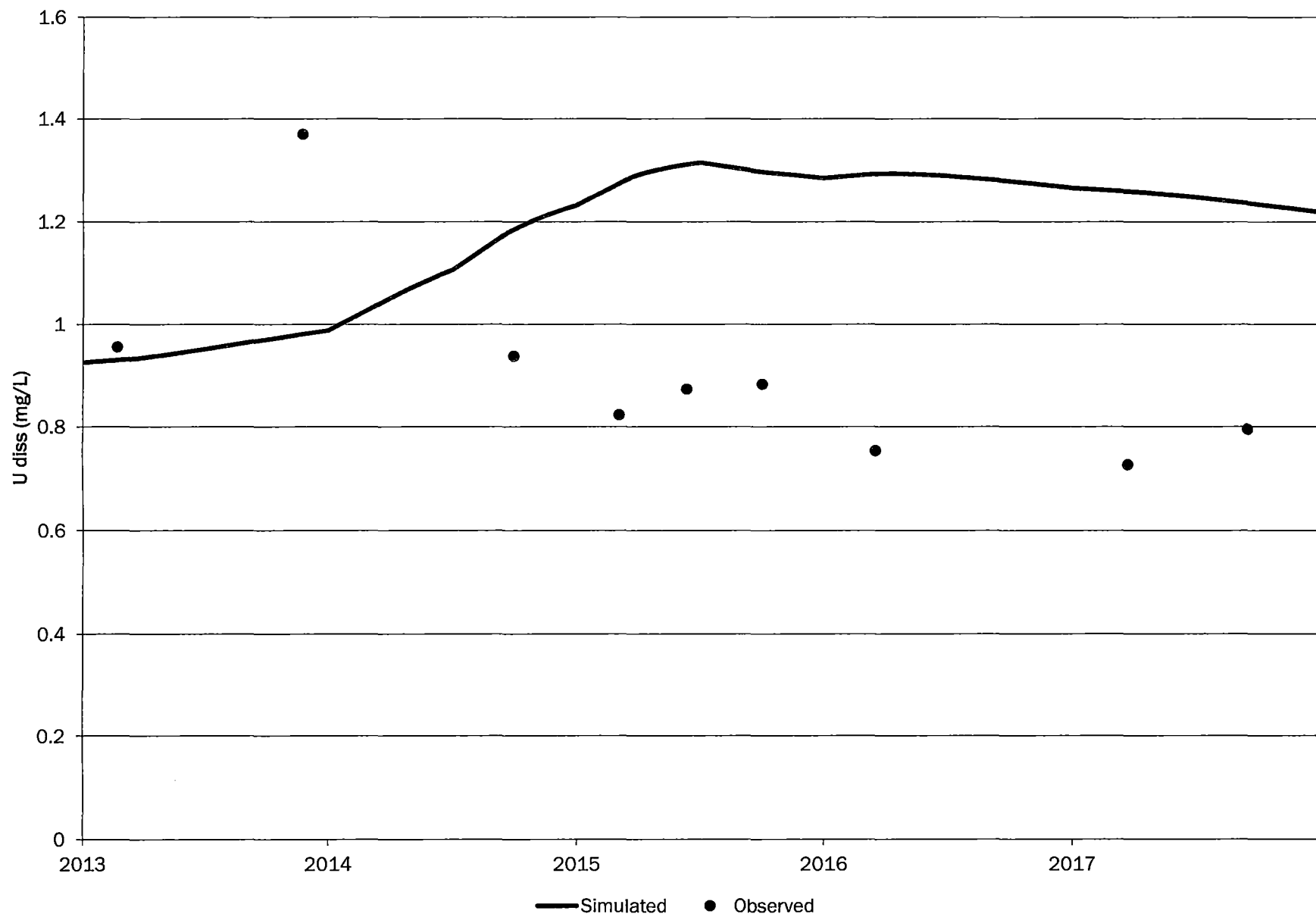
ML-AI



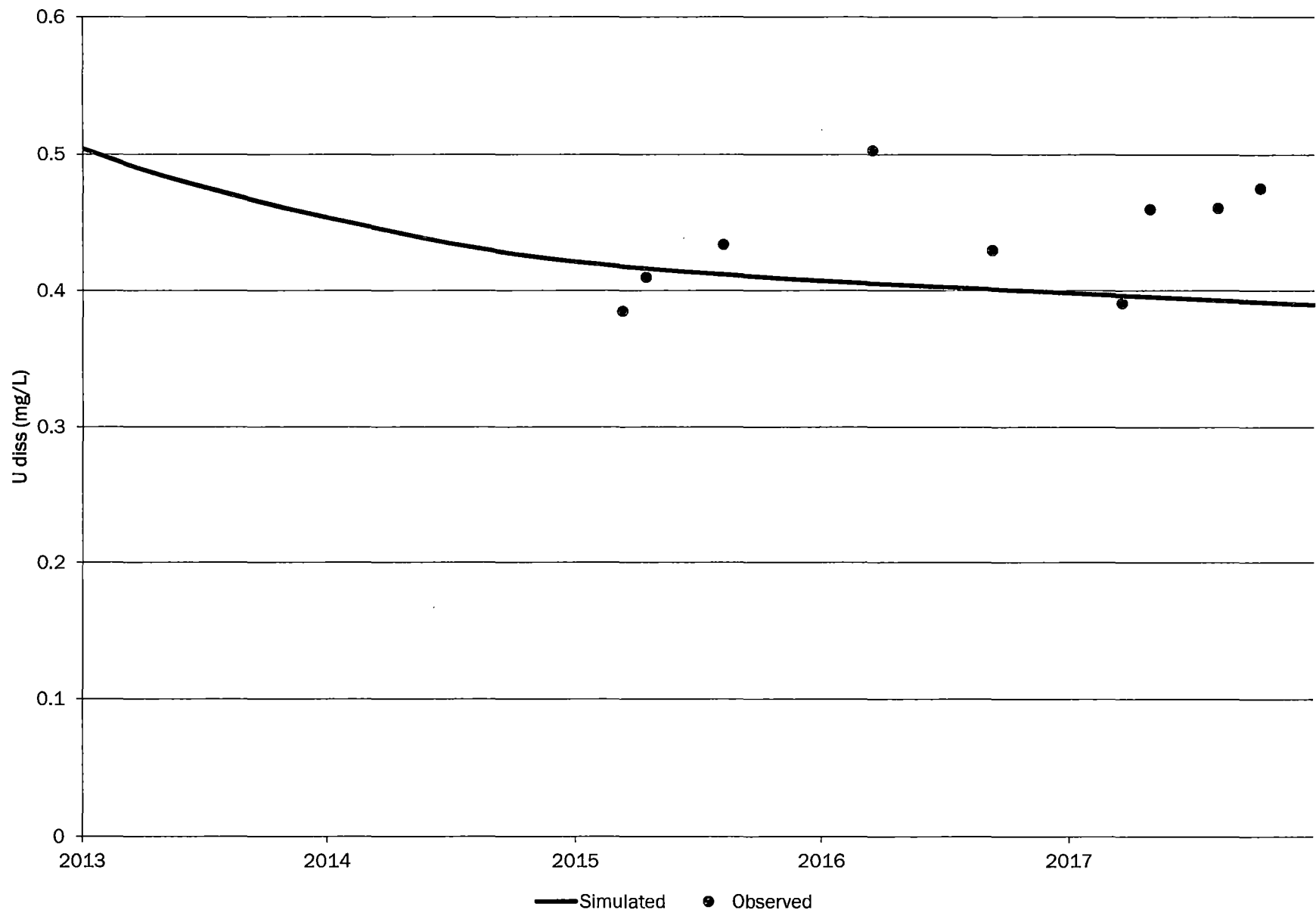
MO-AI



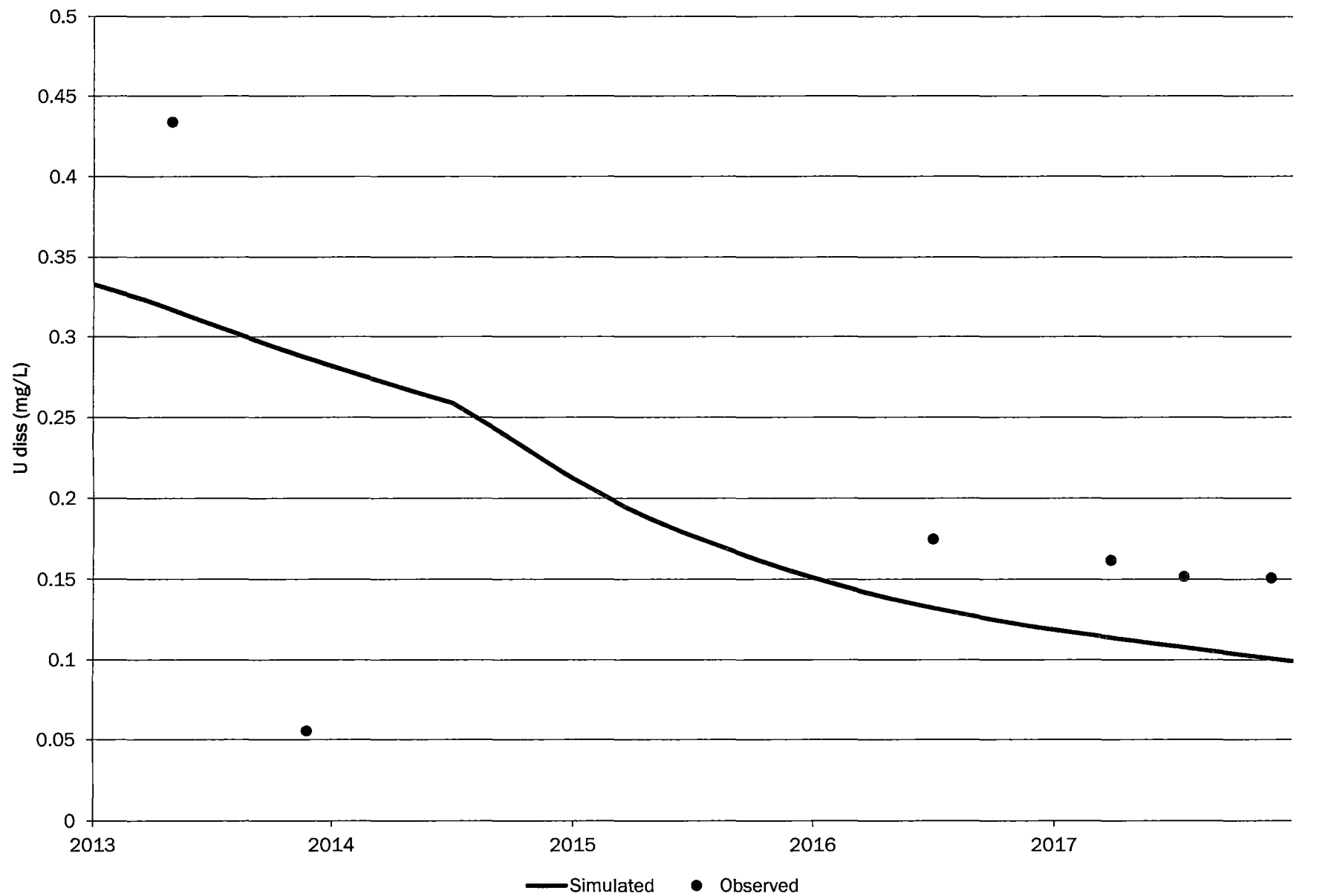
MQ-AI



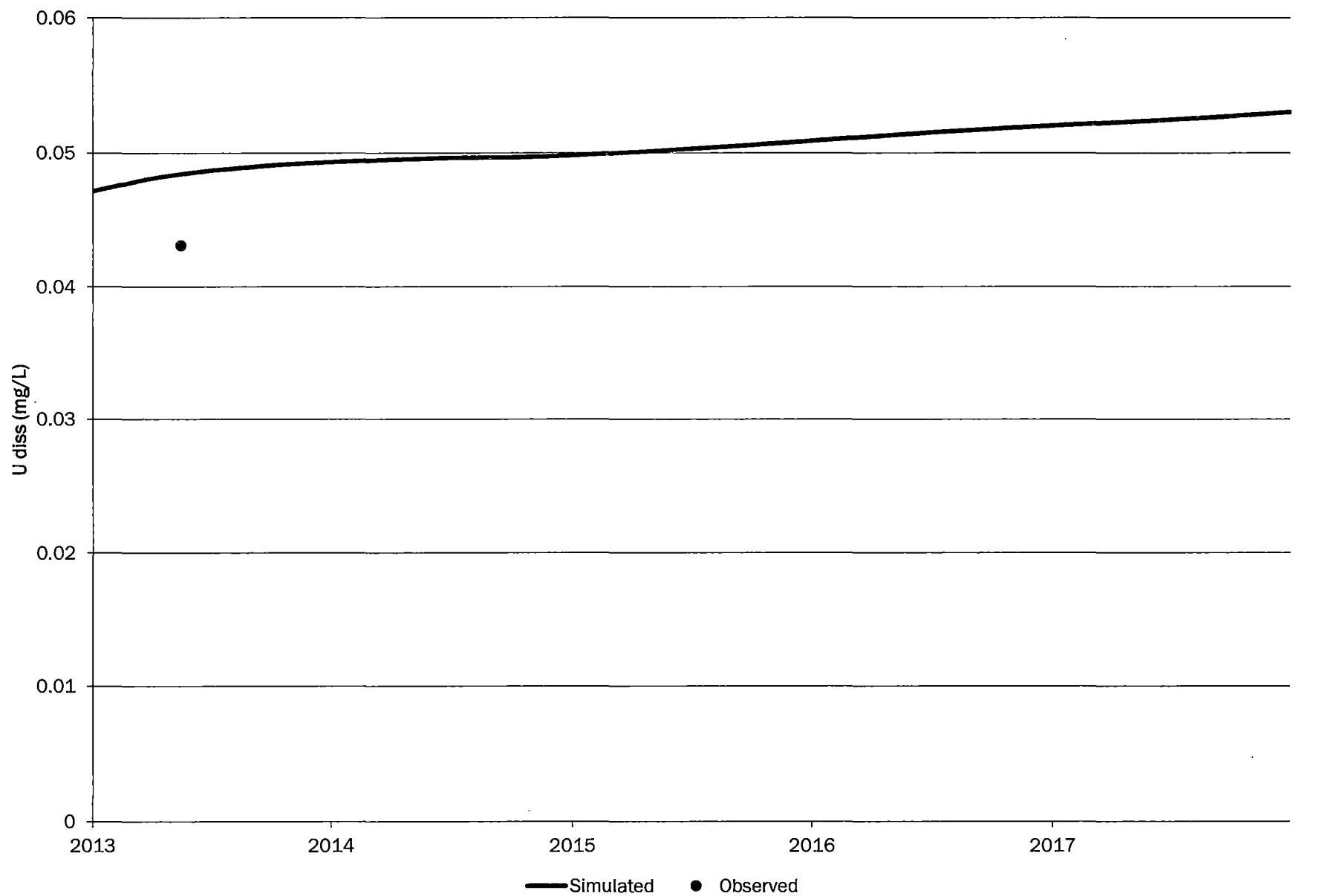
MR-AI



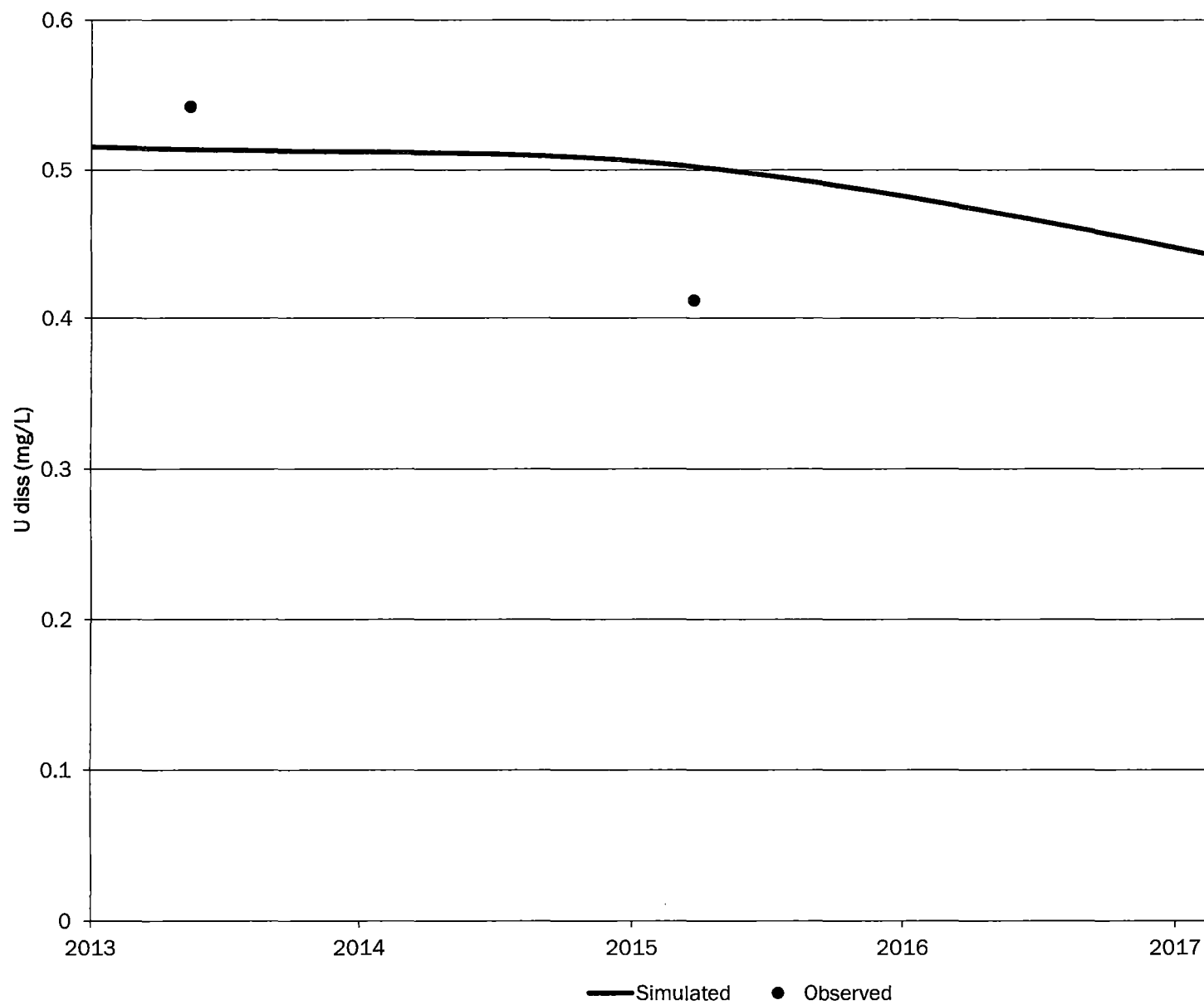
MS-AI



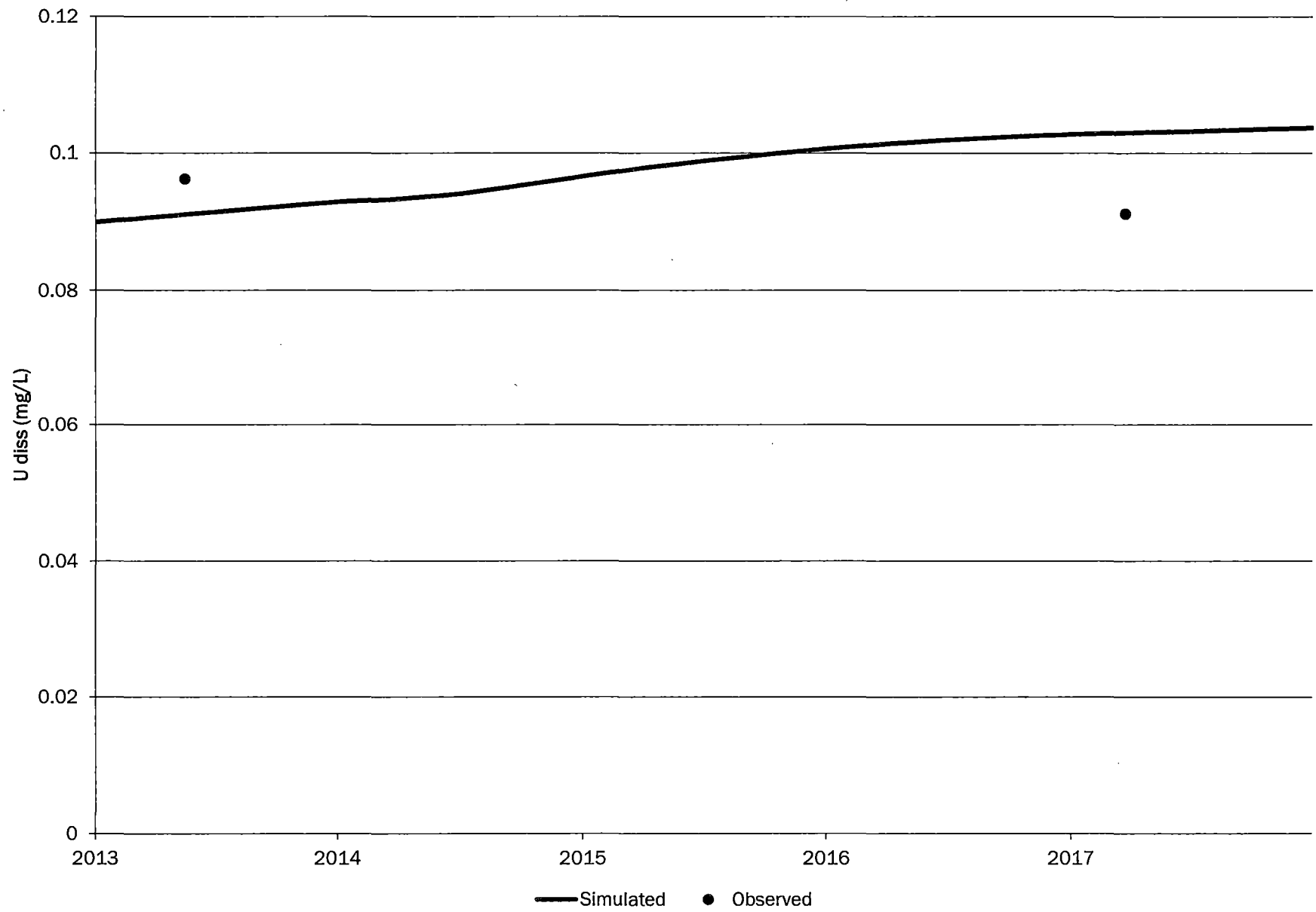
MT-AI



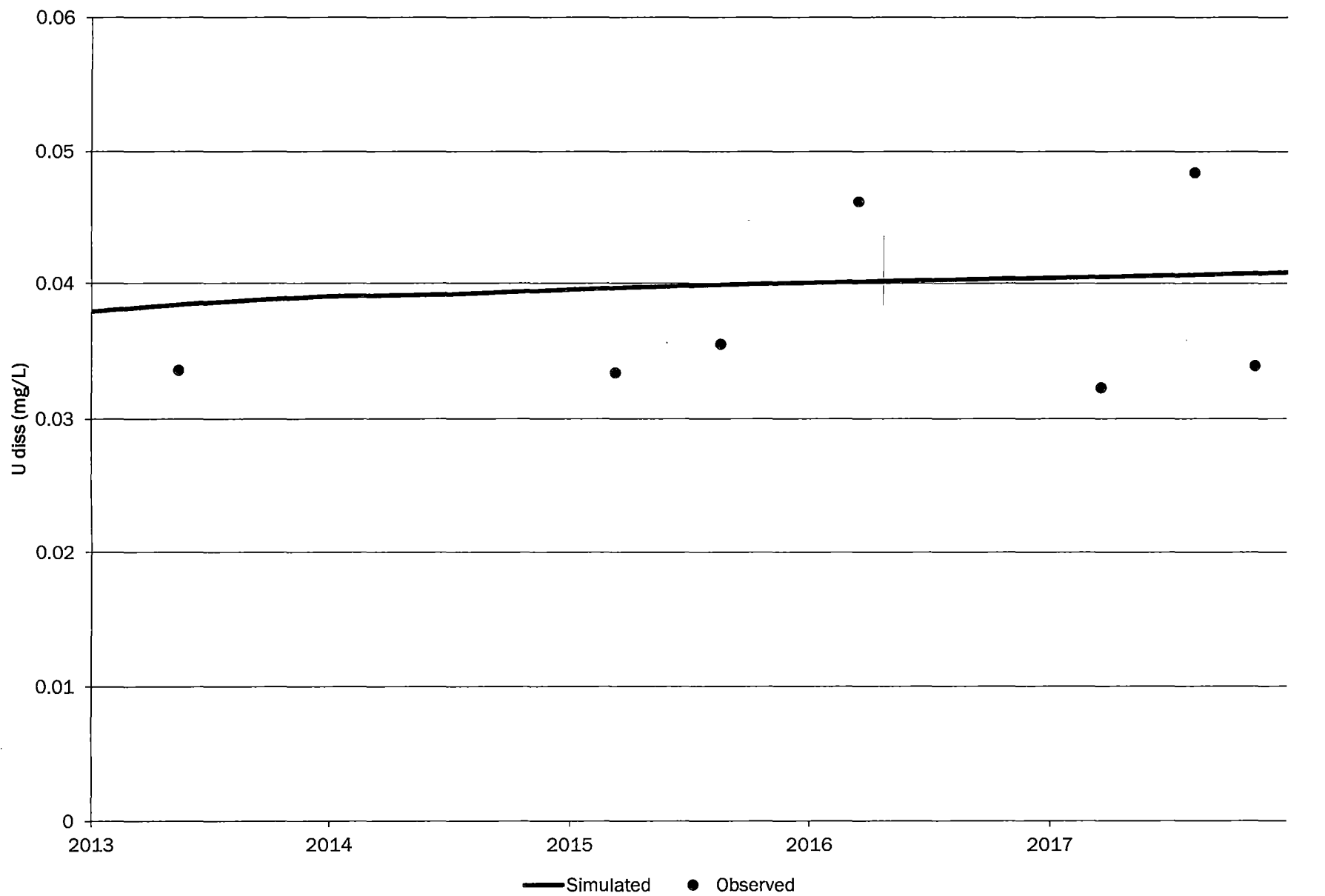
MV-AI



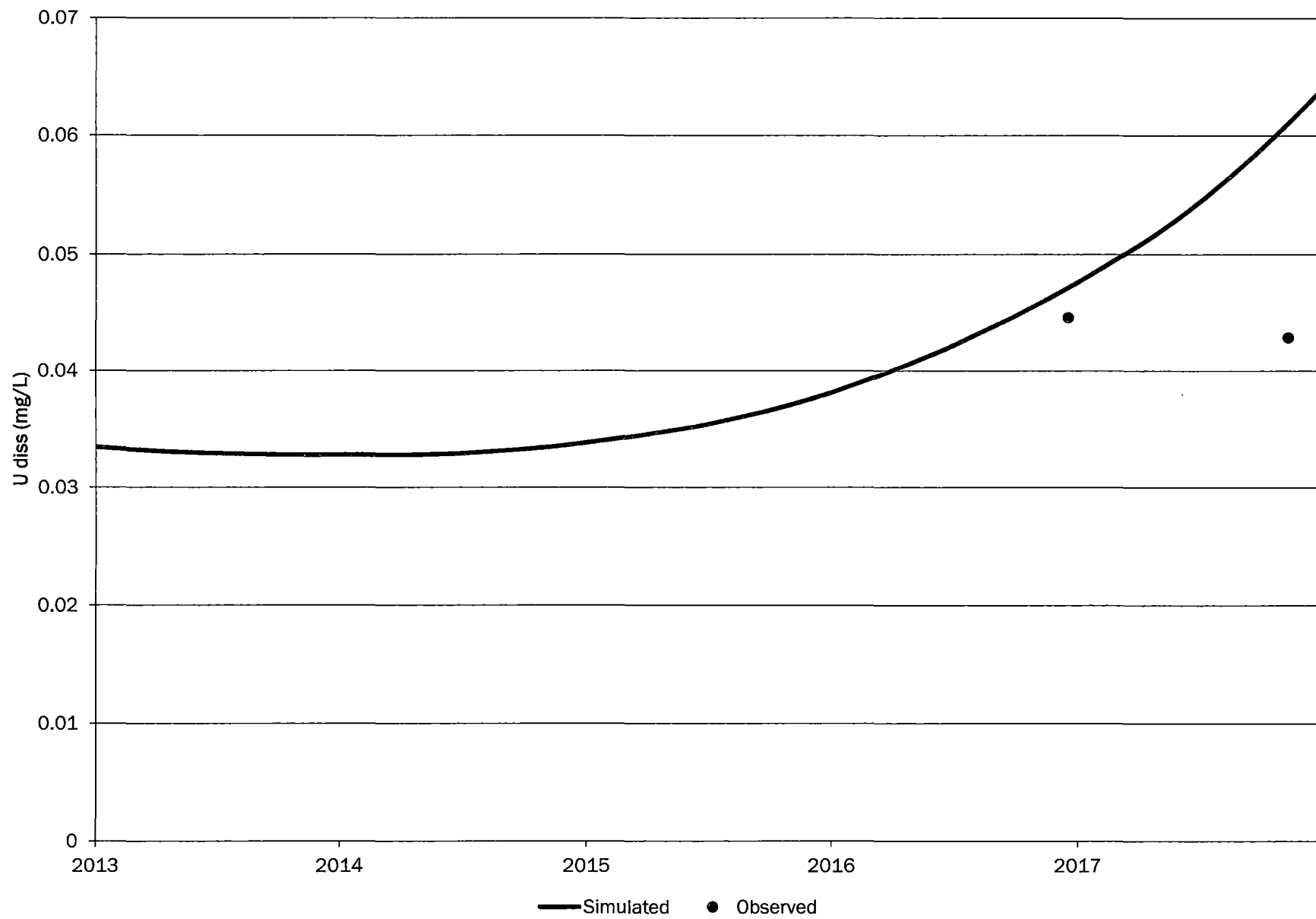
MW-AI



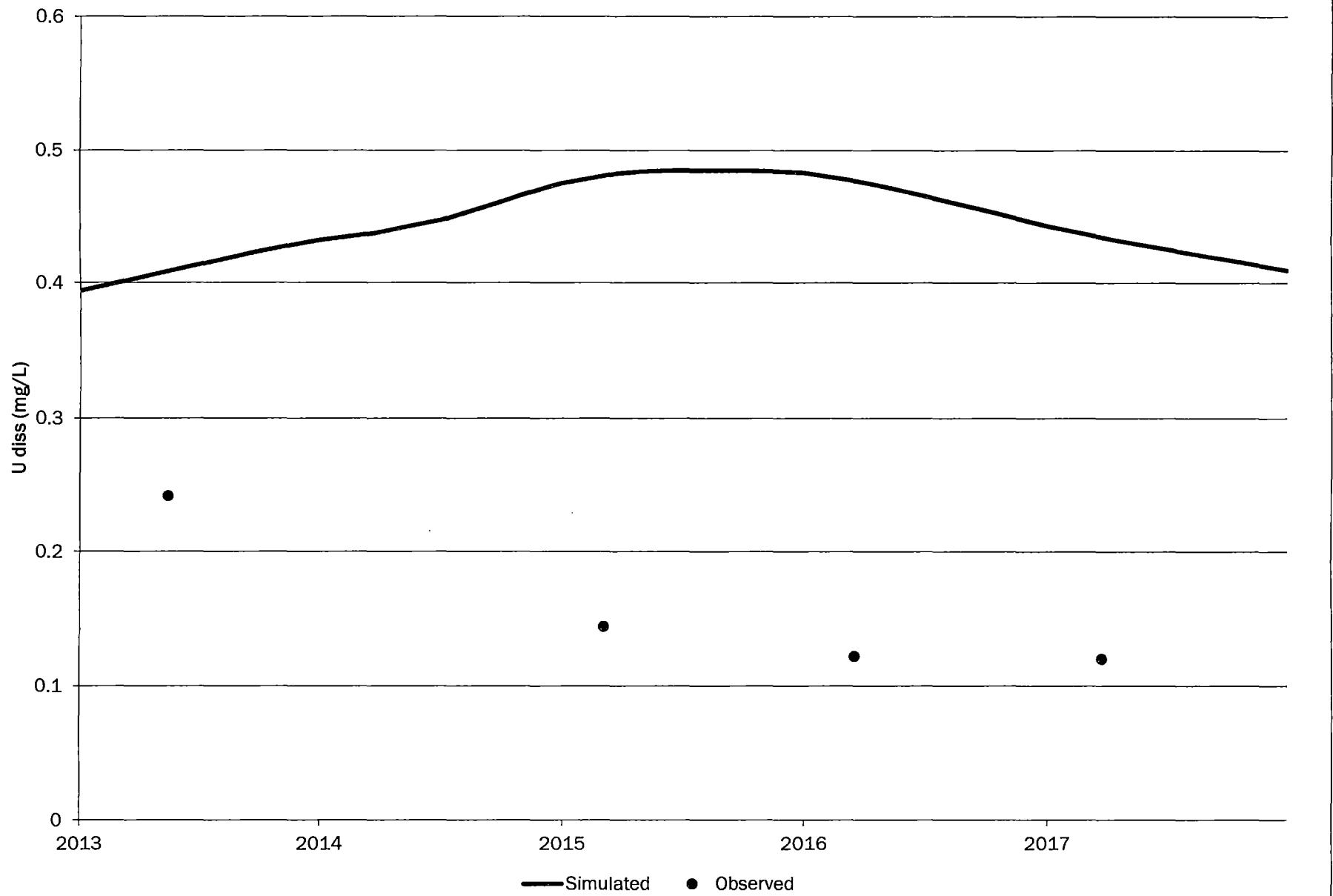
MX-AI



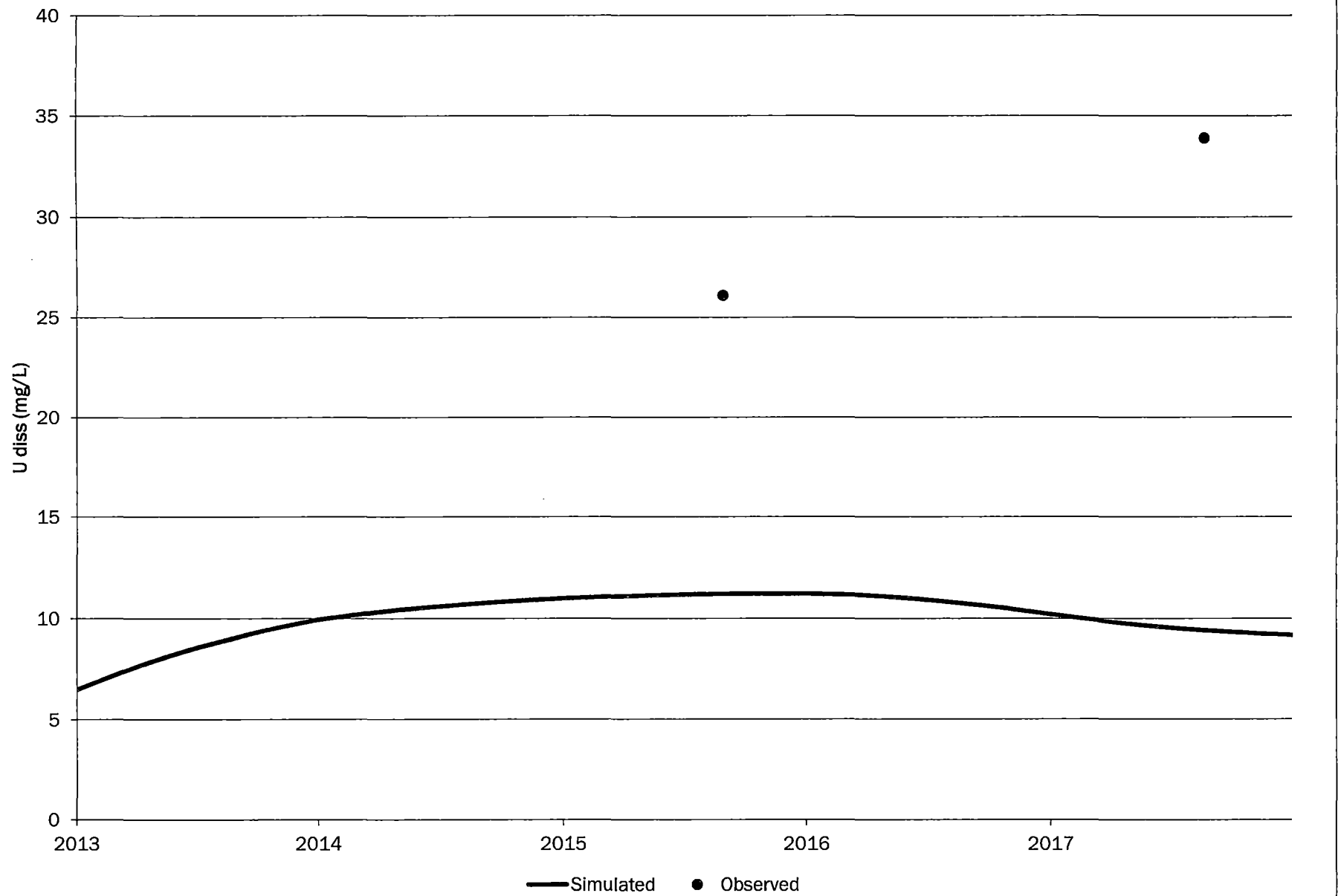
MY-AI



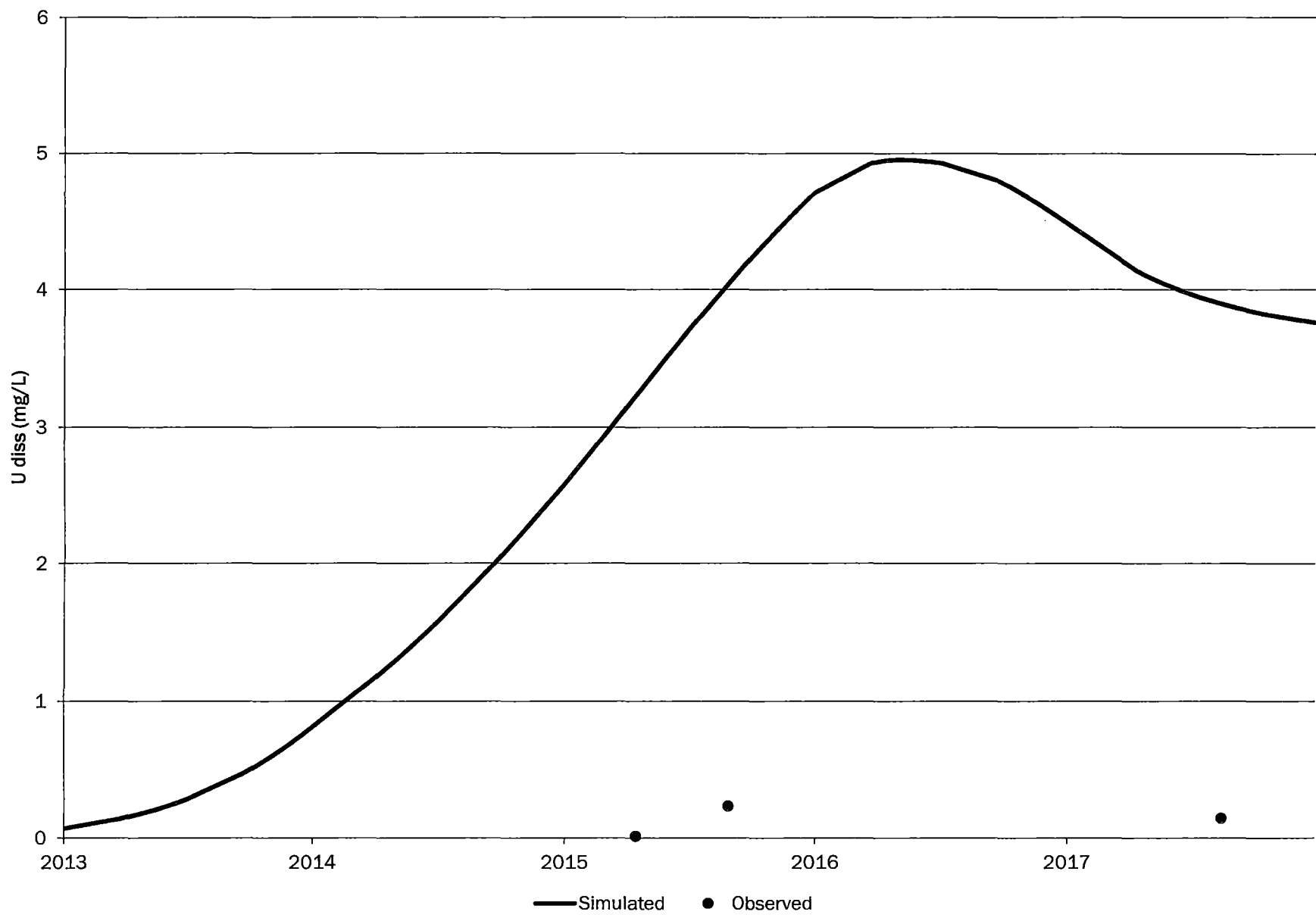
MZ-AI



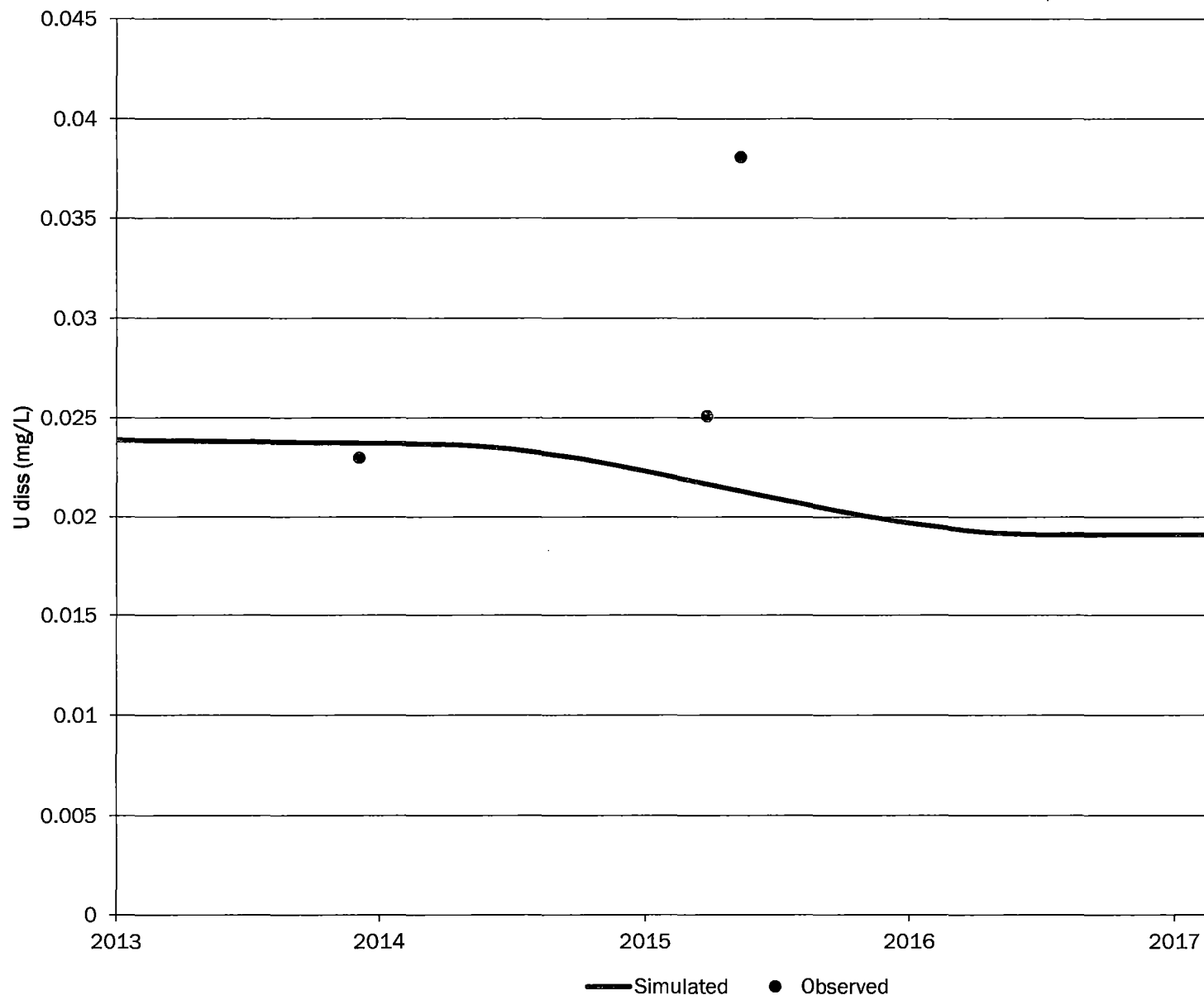
NB-AI



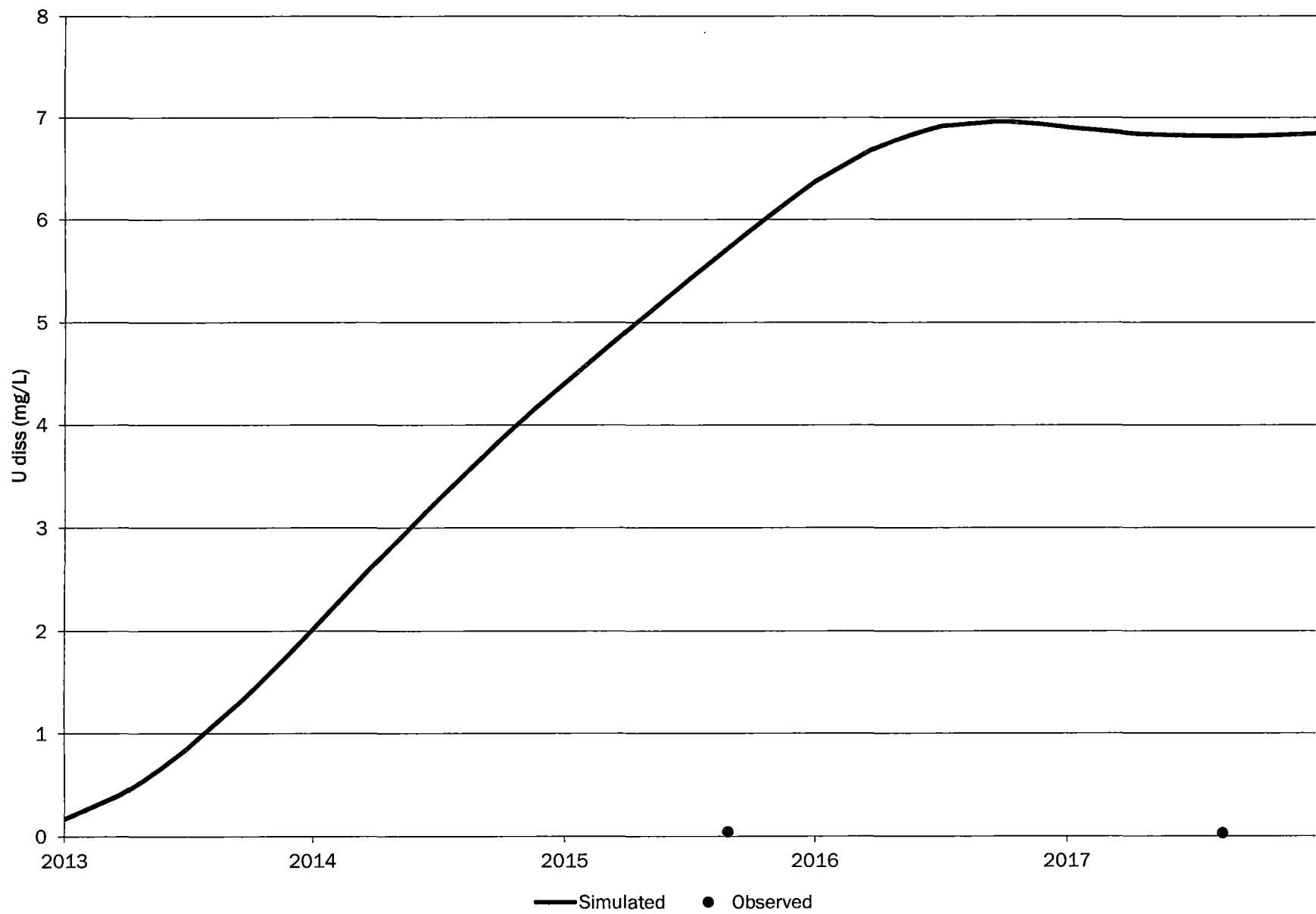
NC-AI



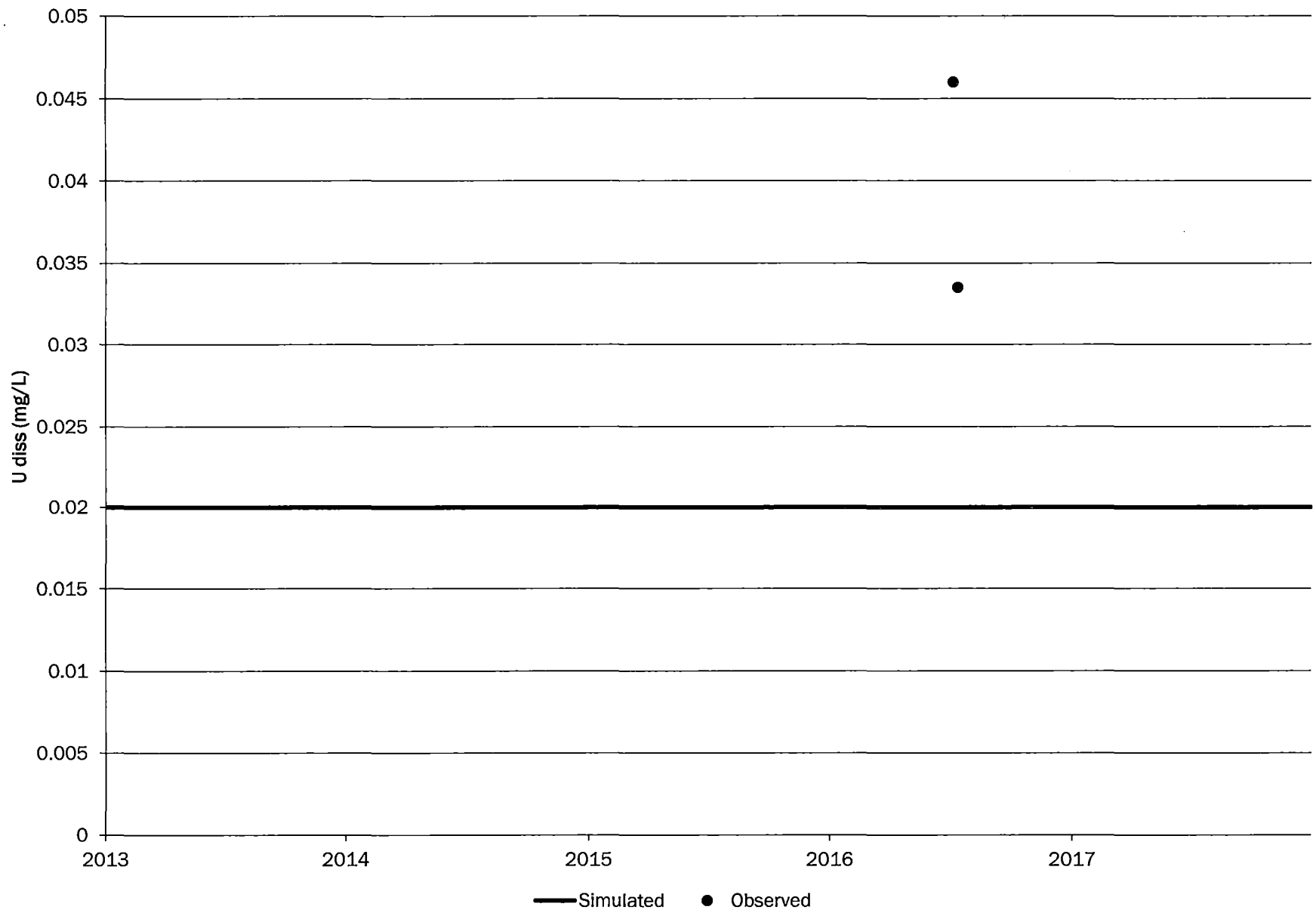
ND-AI



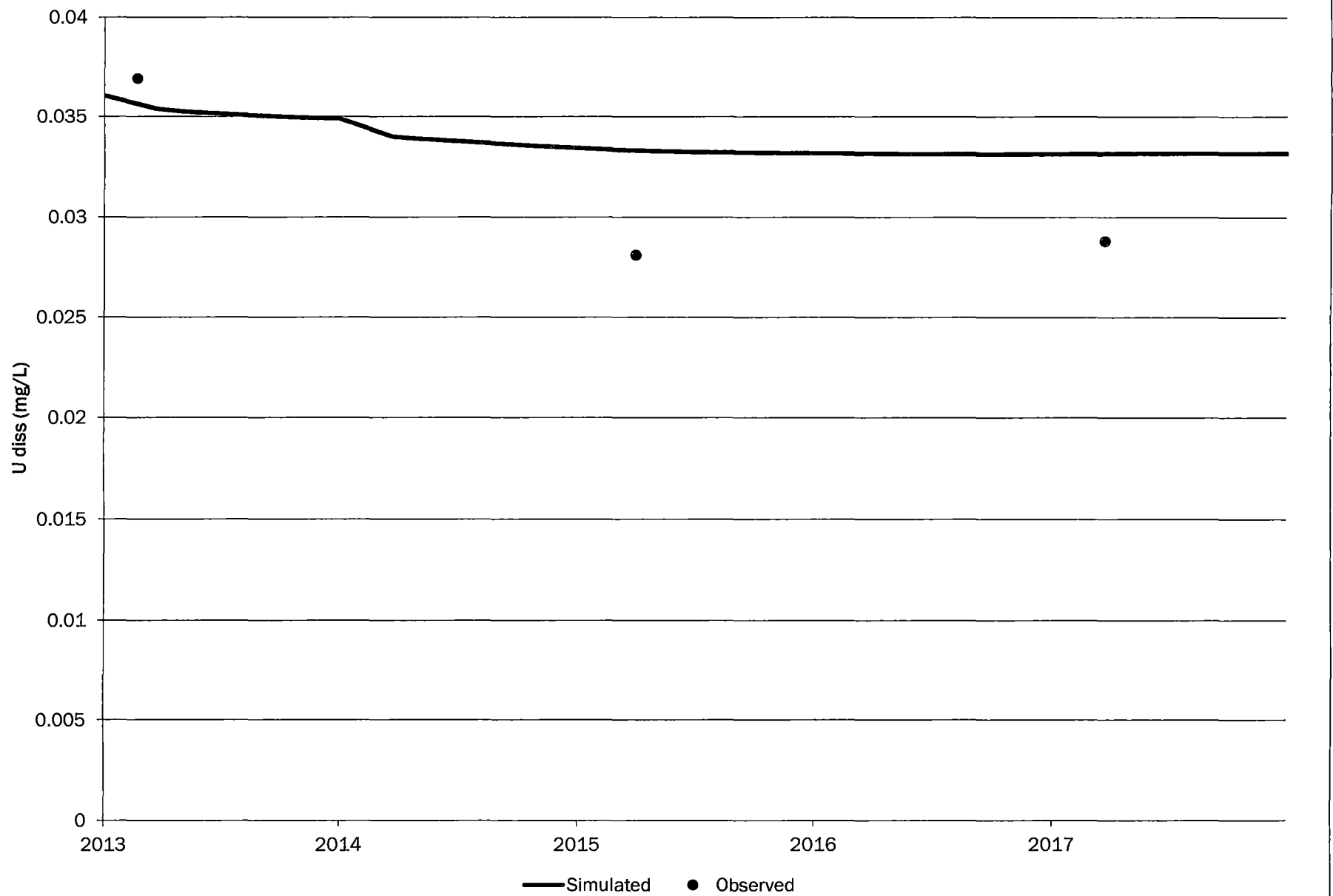
O-Al



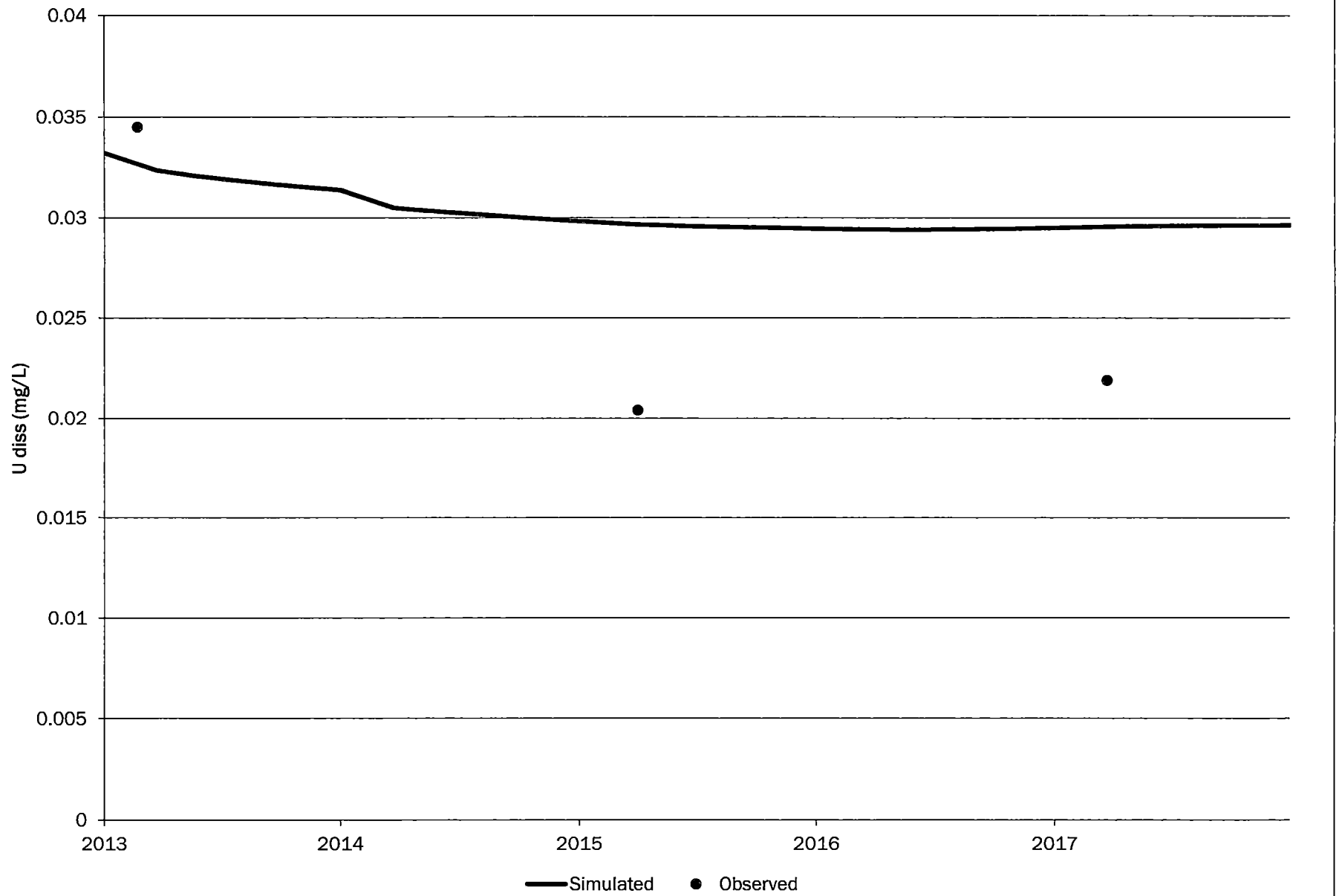
OLD #1-SA



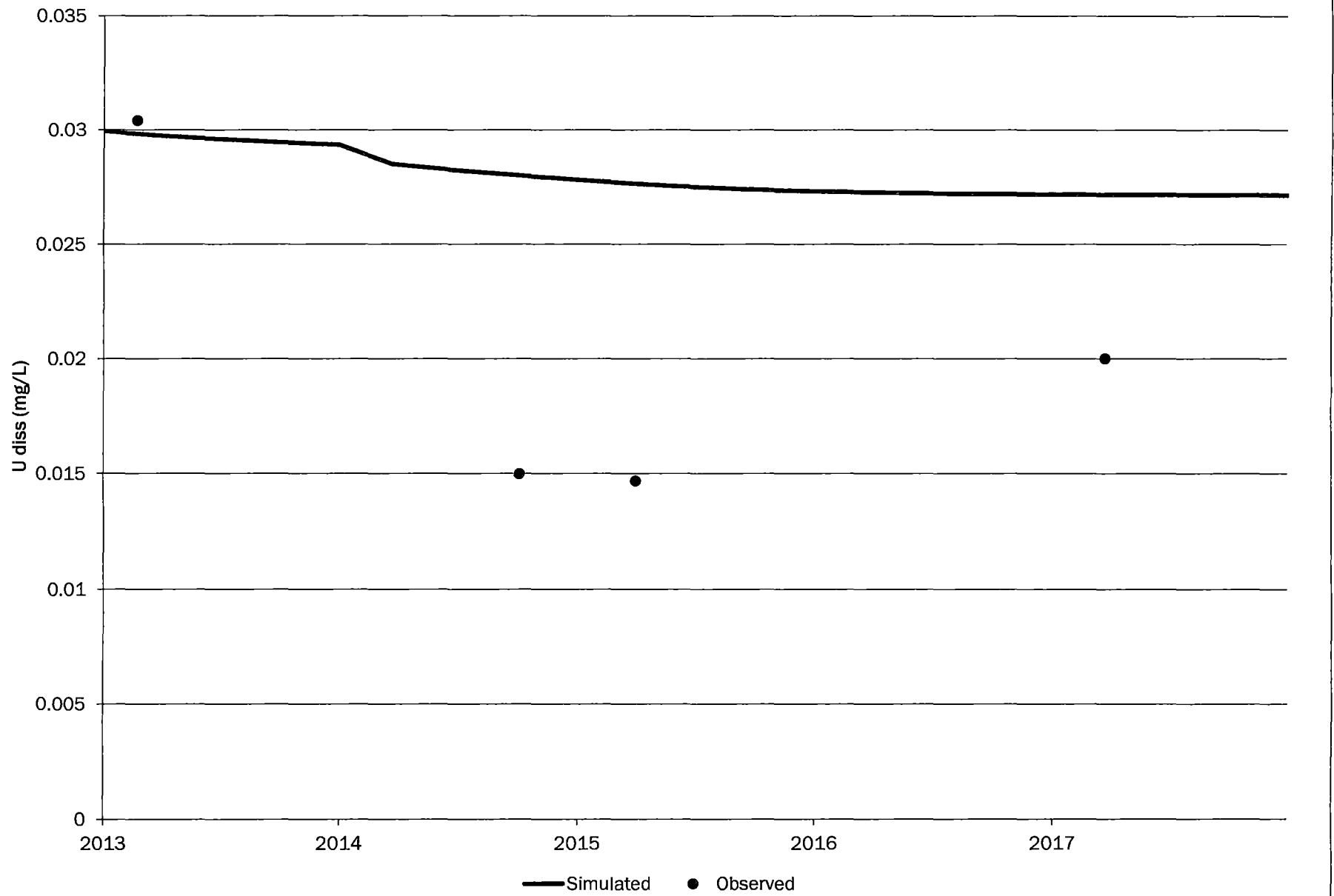
P2-AI



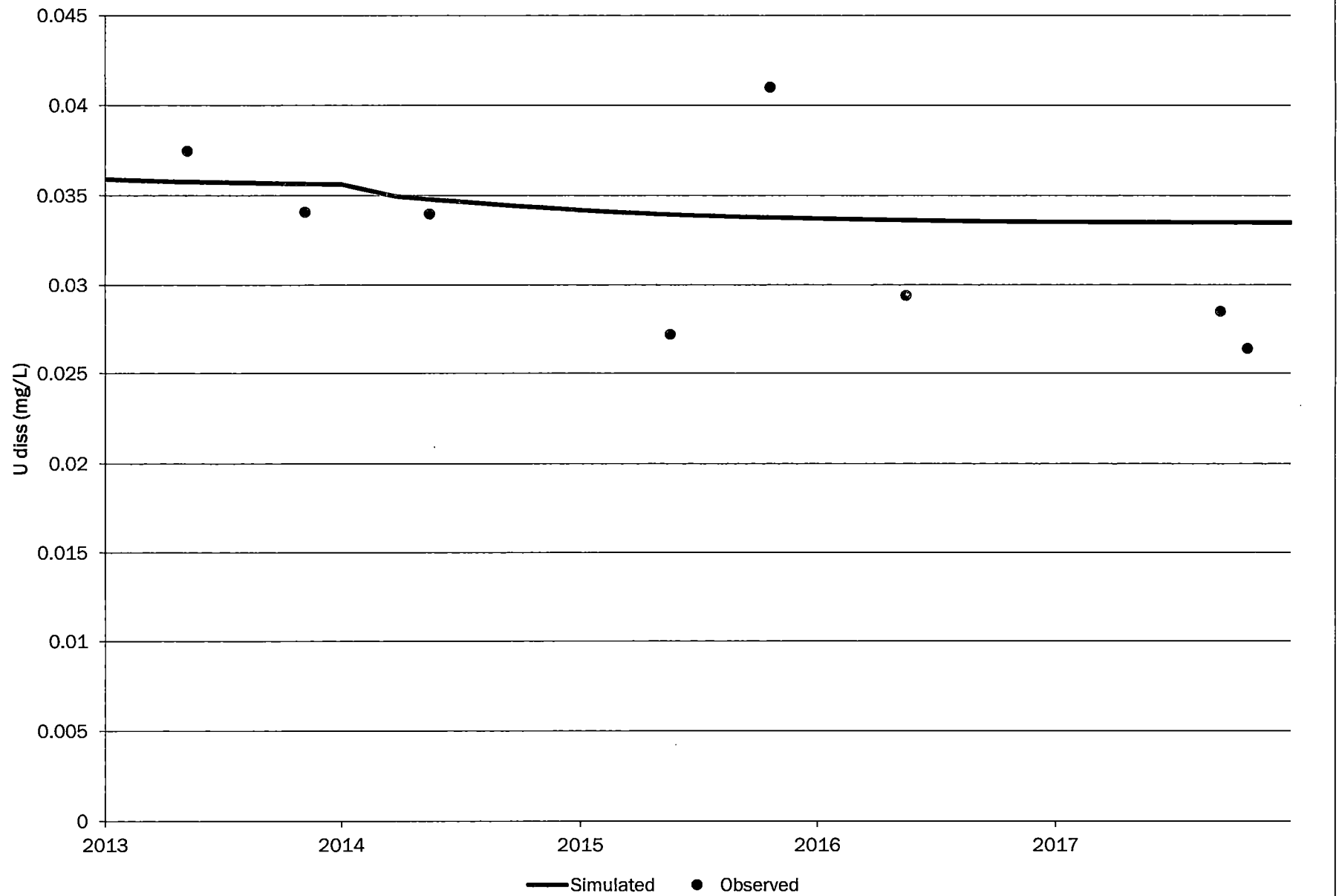
P3-AI



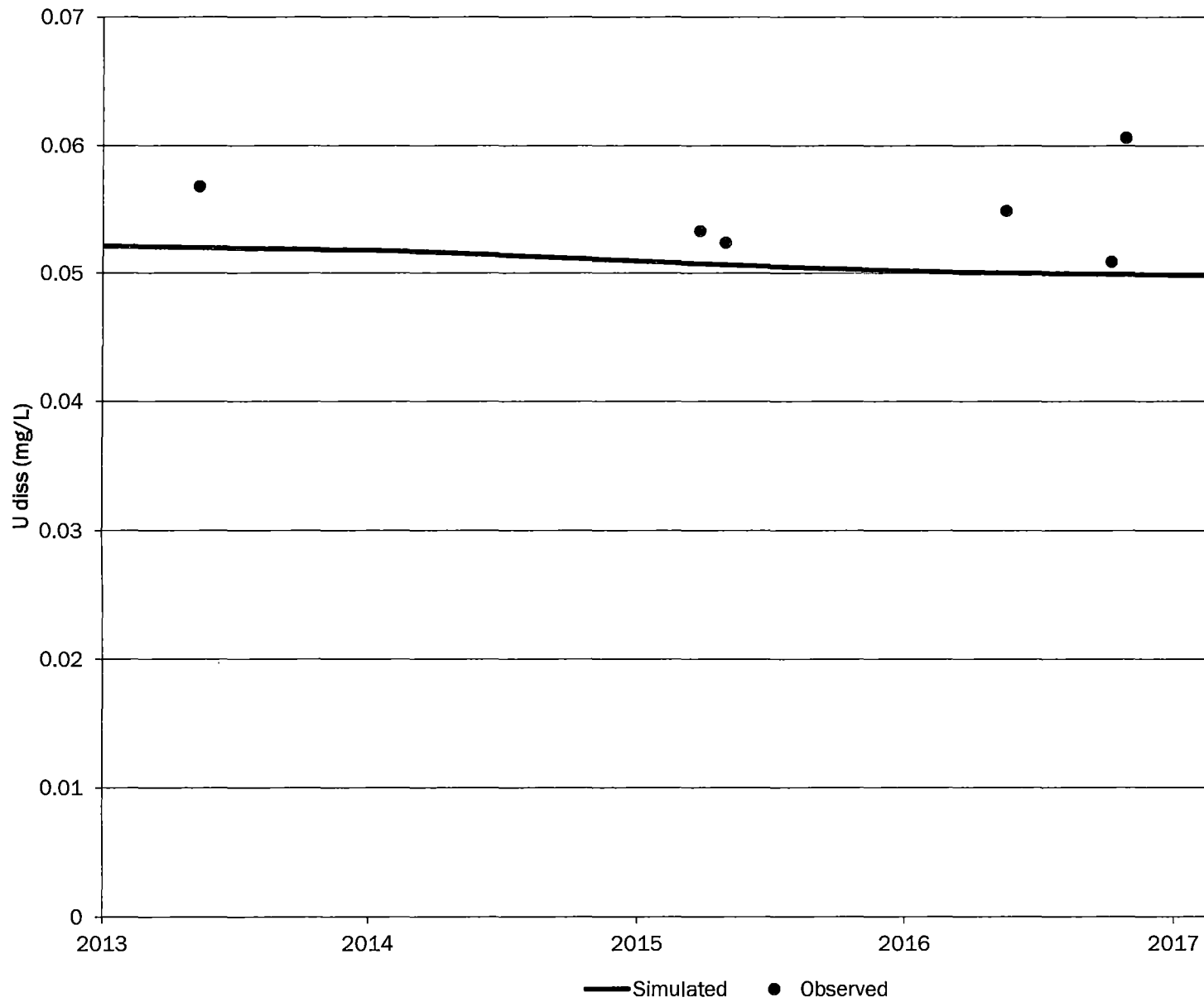
P4-AI



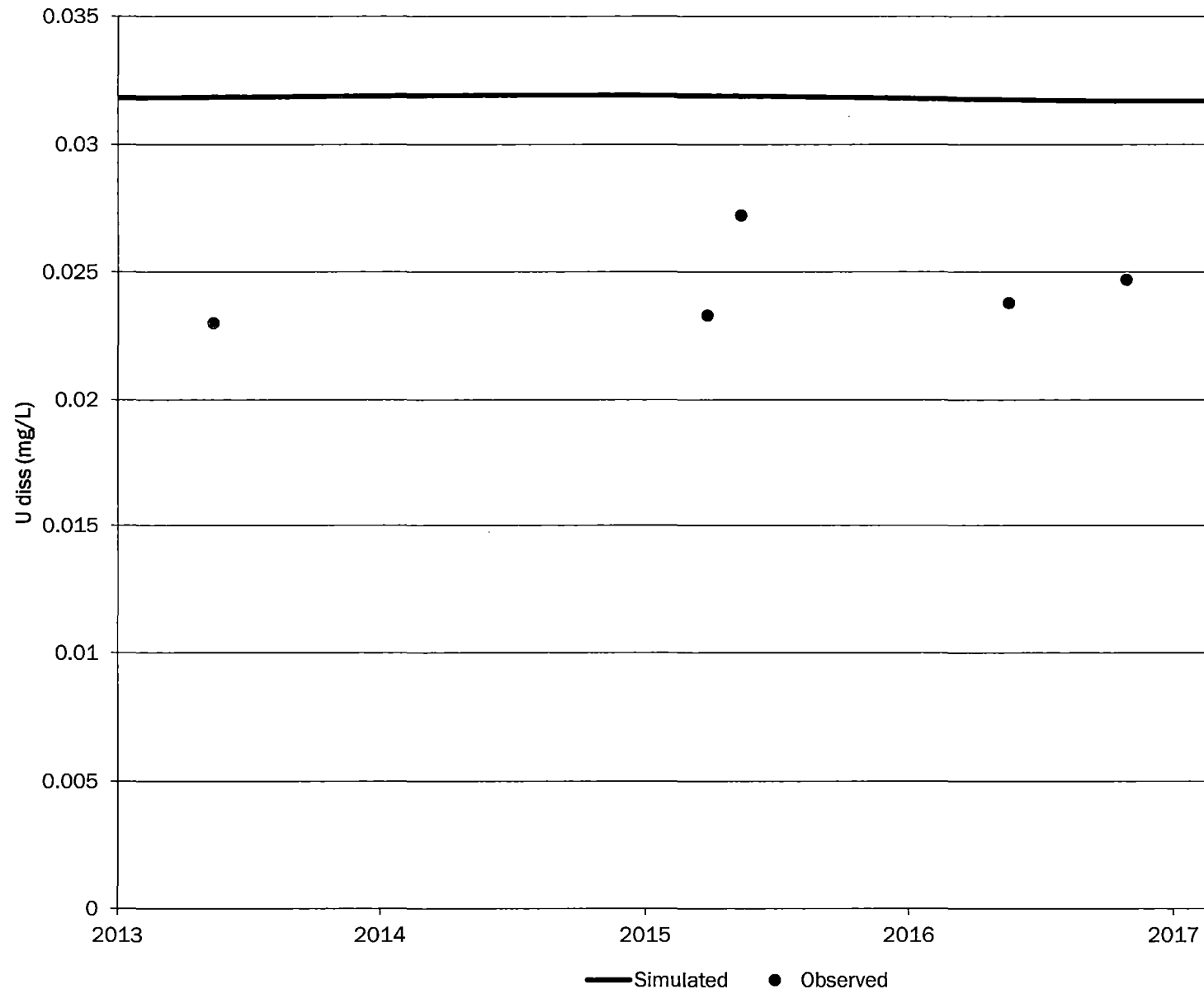
P-AI



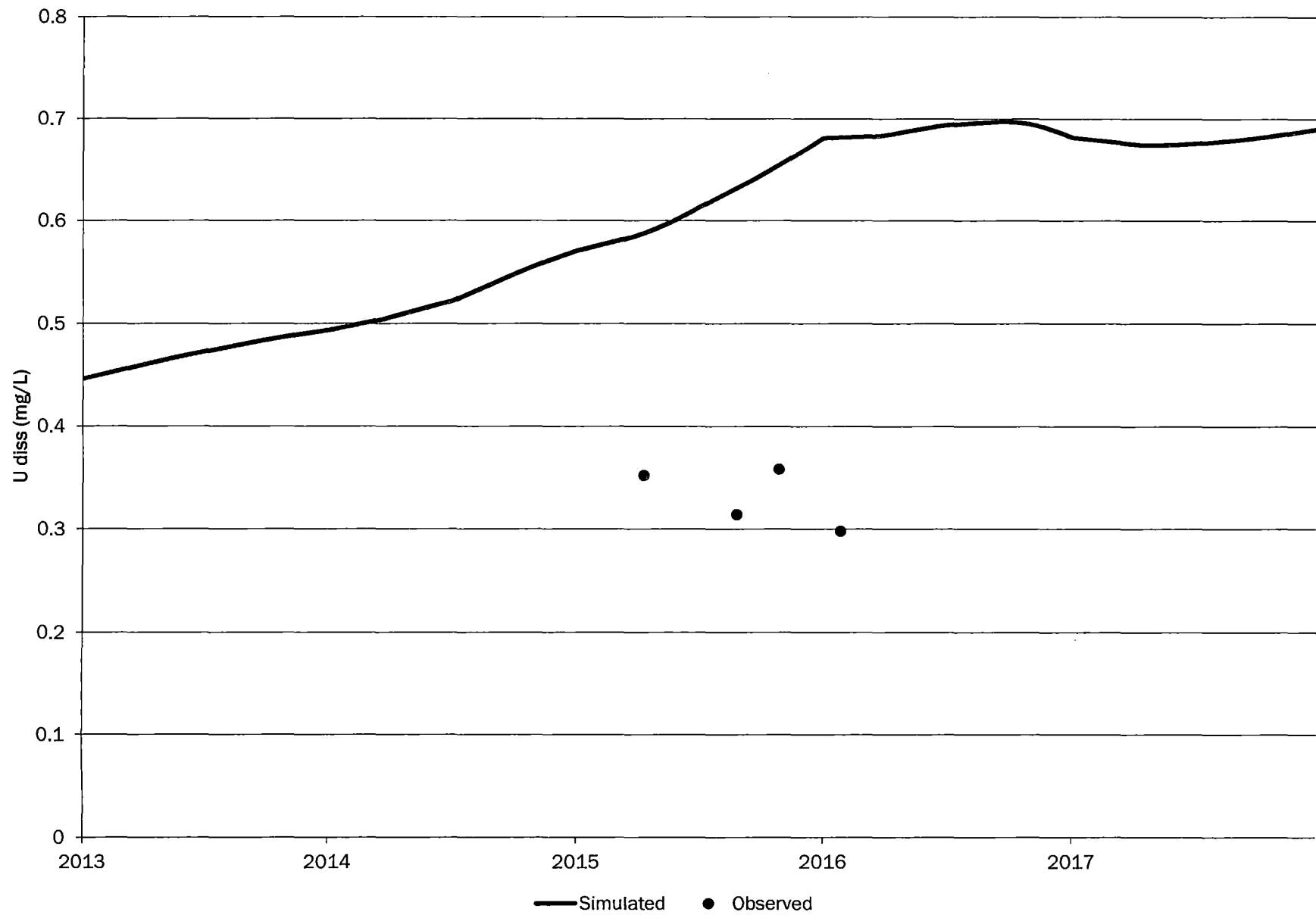
Q-AI



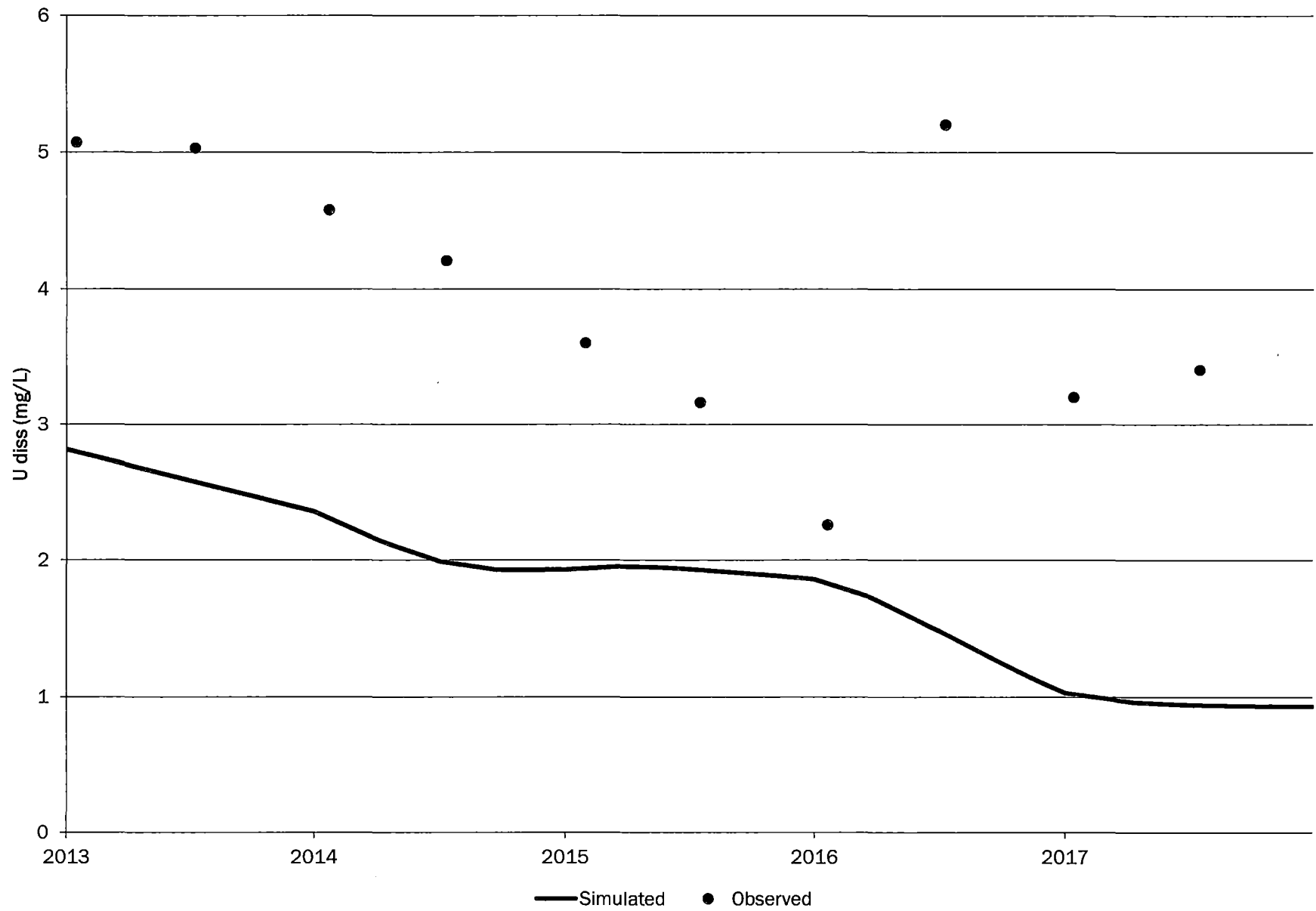
R-AI



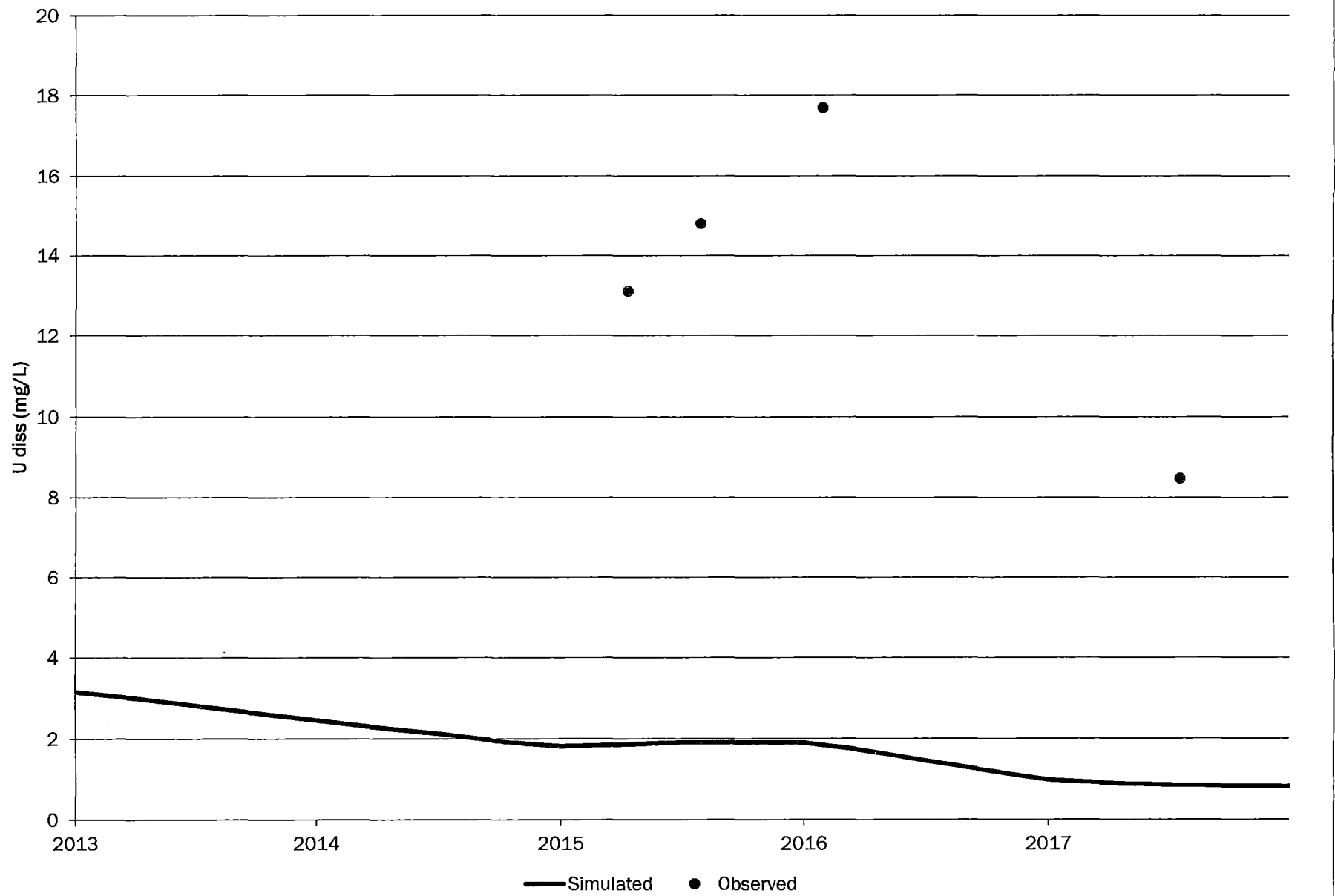
S1-AI



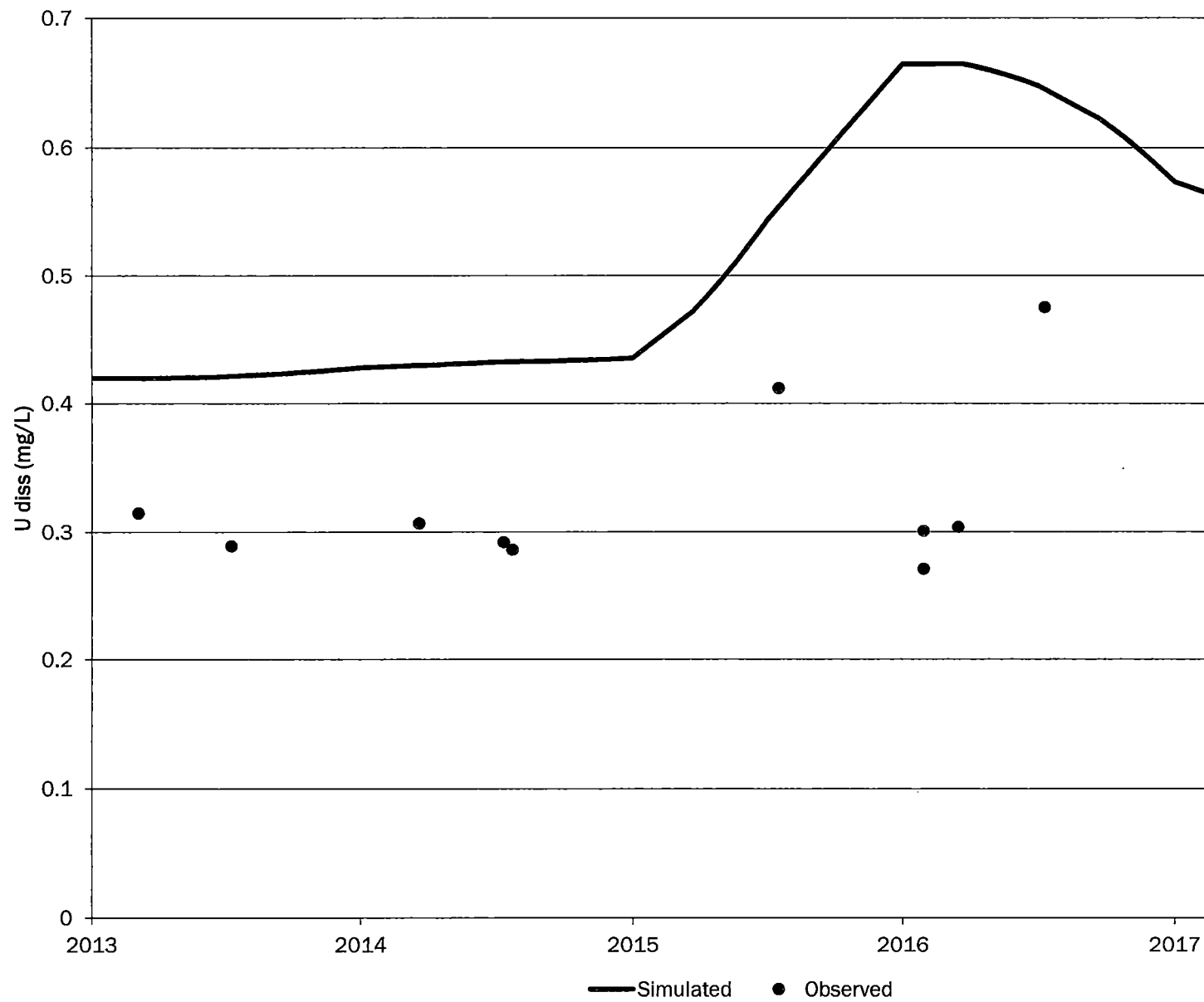
S2-AI



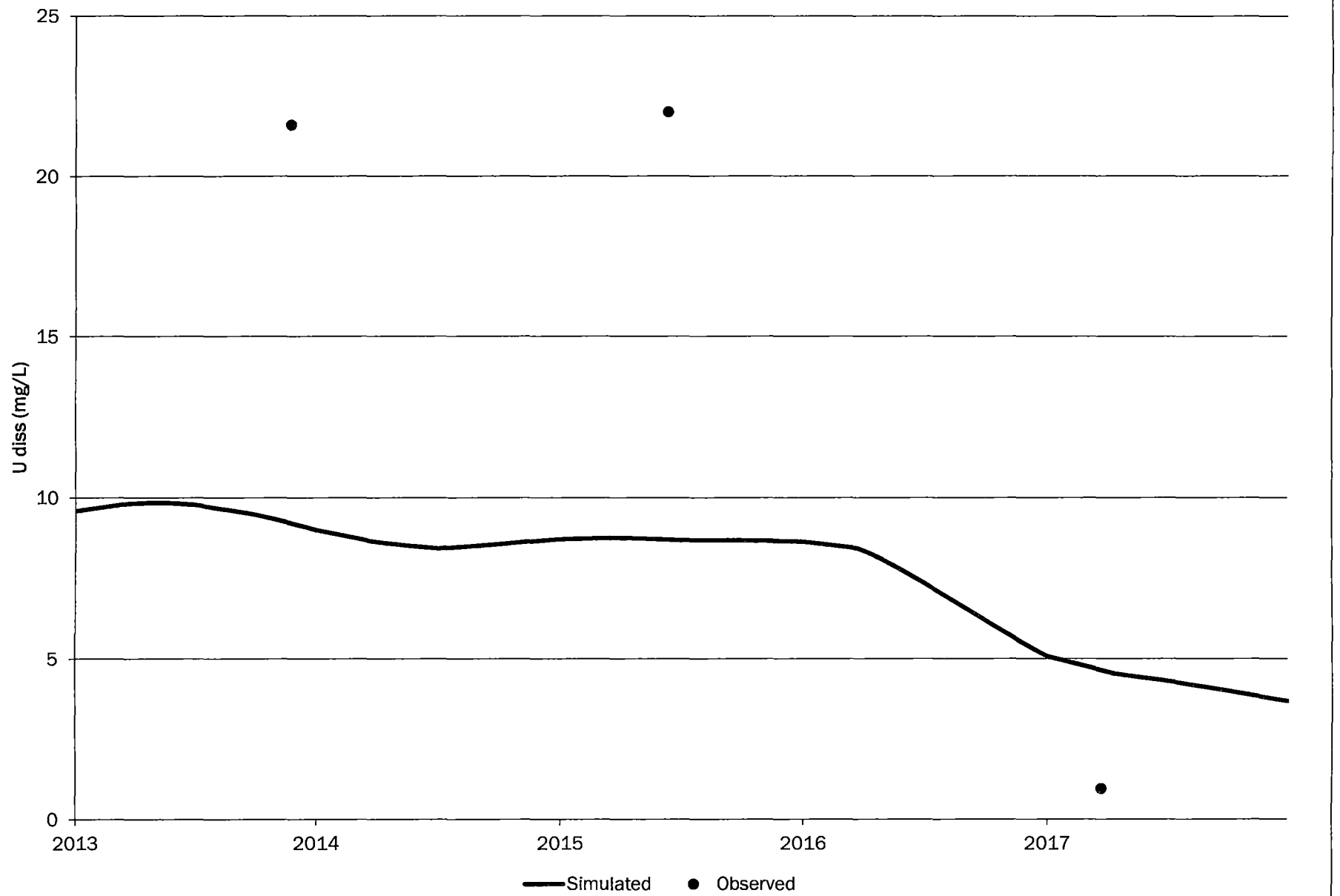
S3-AI



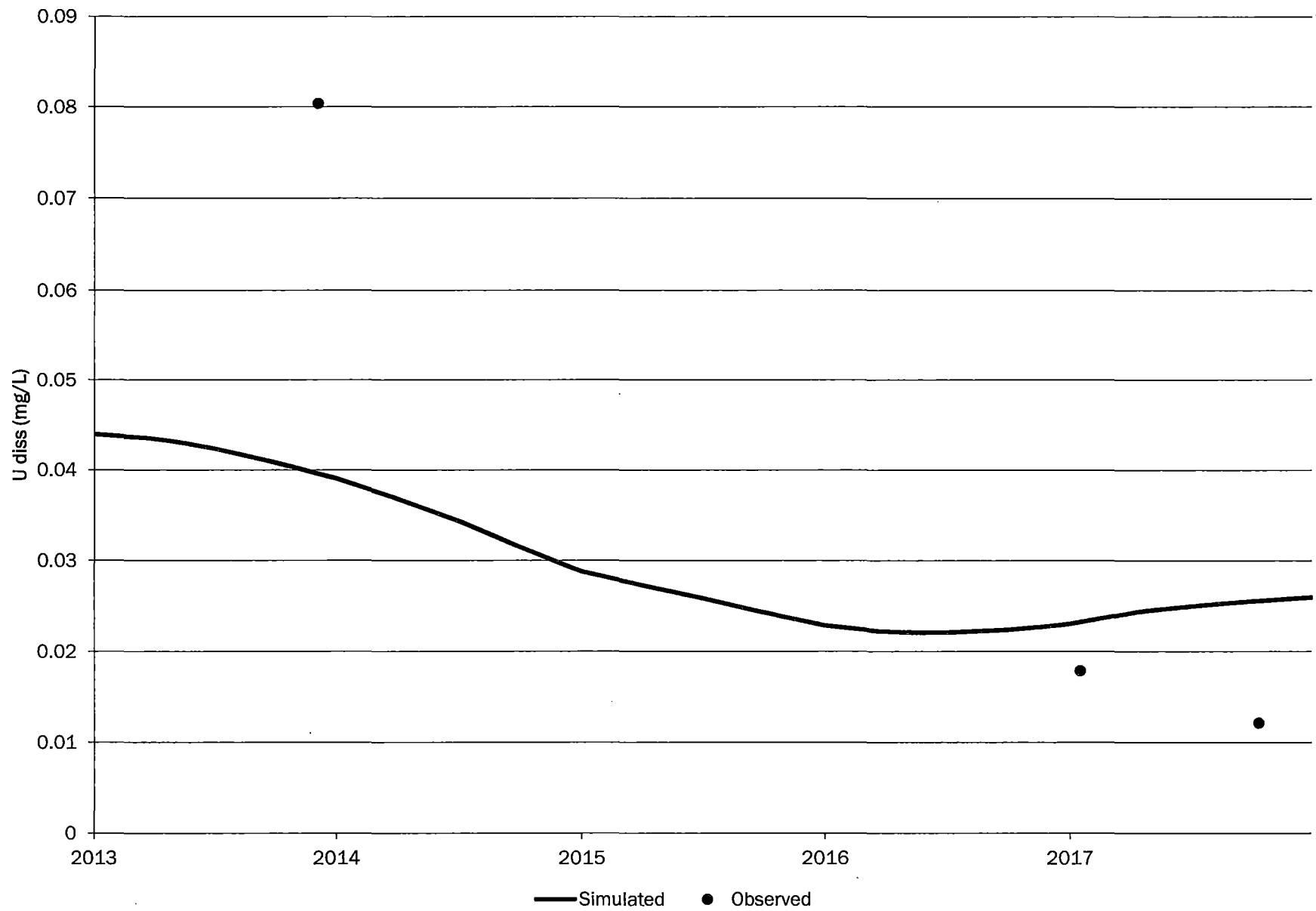
S4-AI



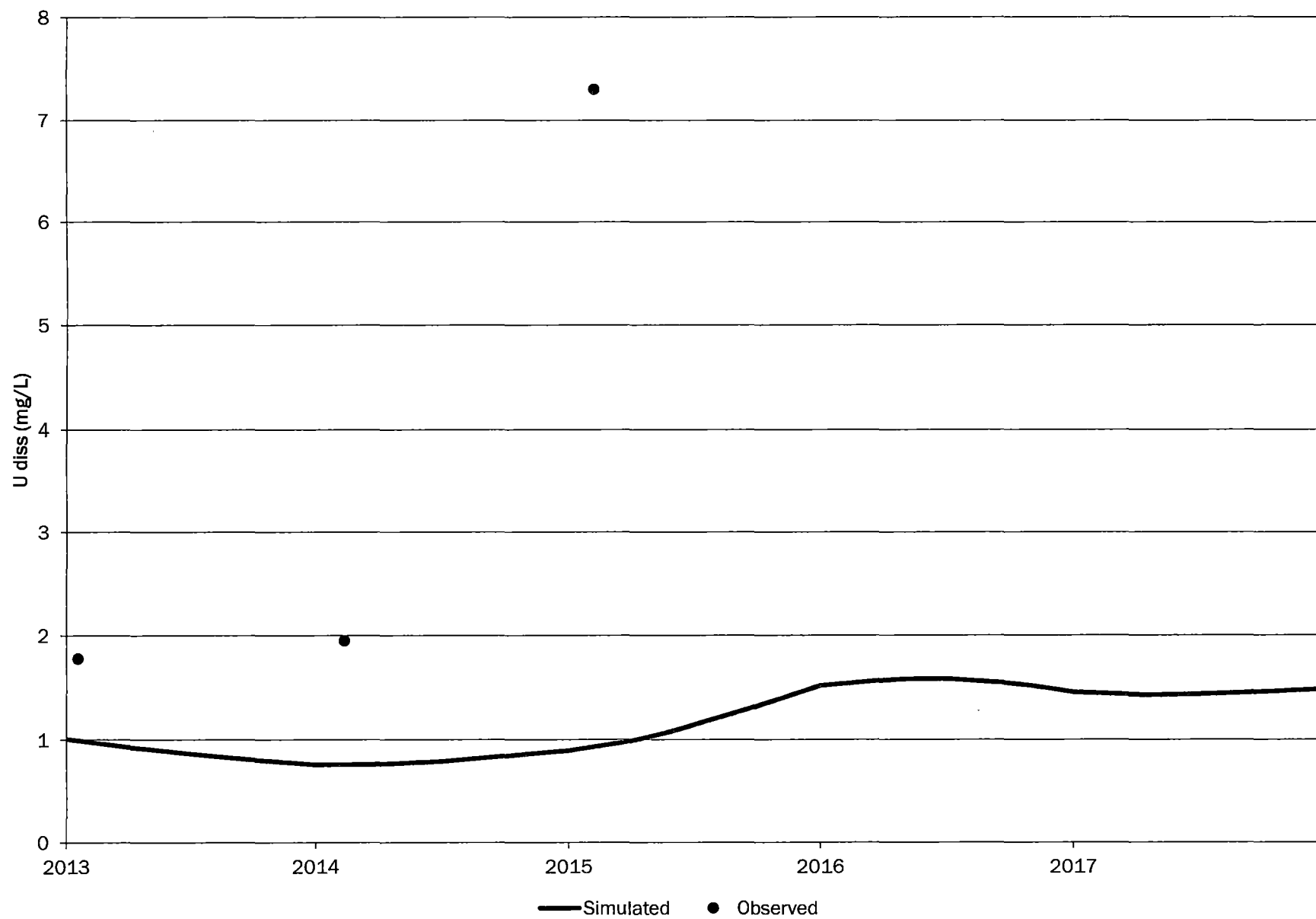
S5R-AI



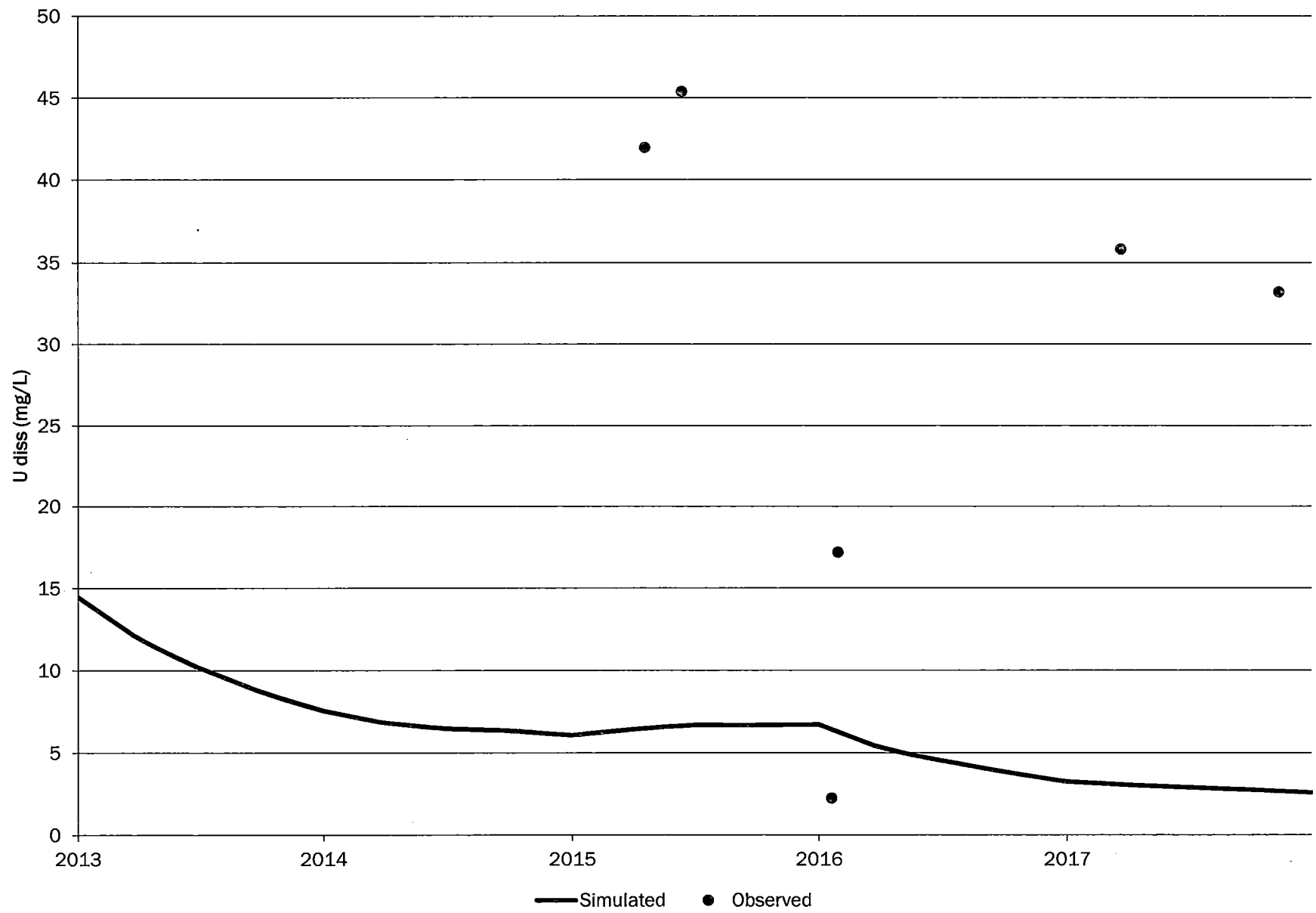
S11-AI



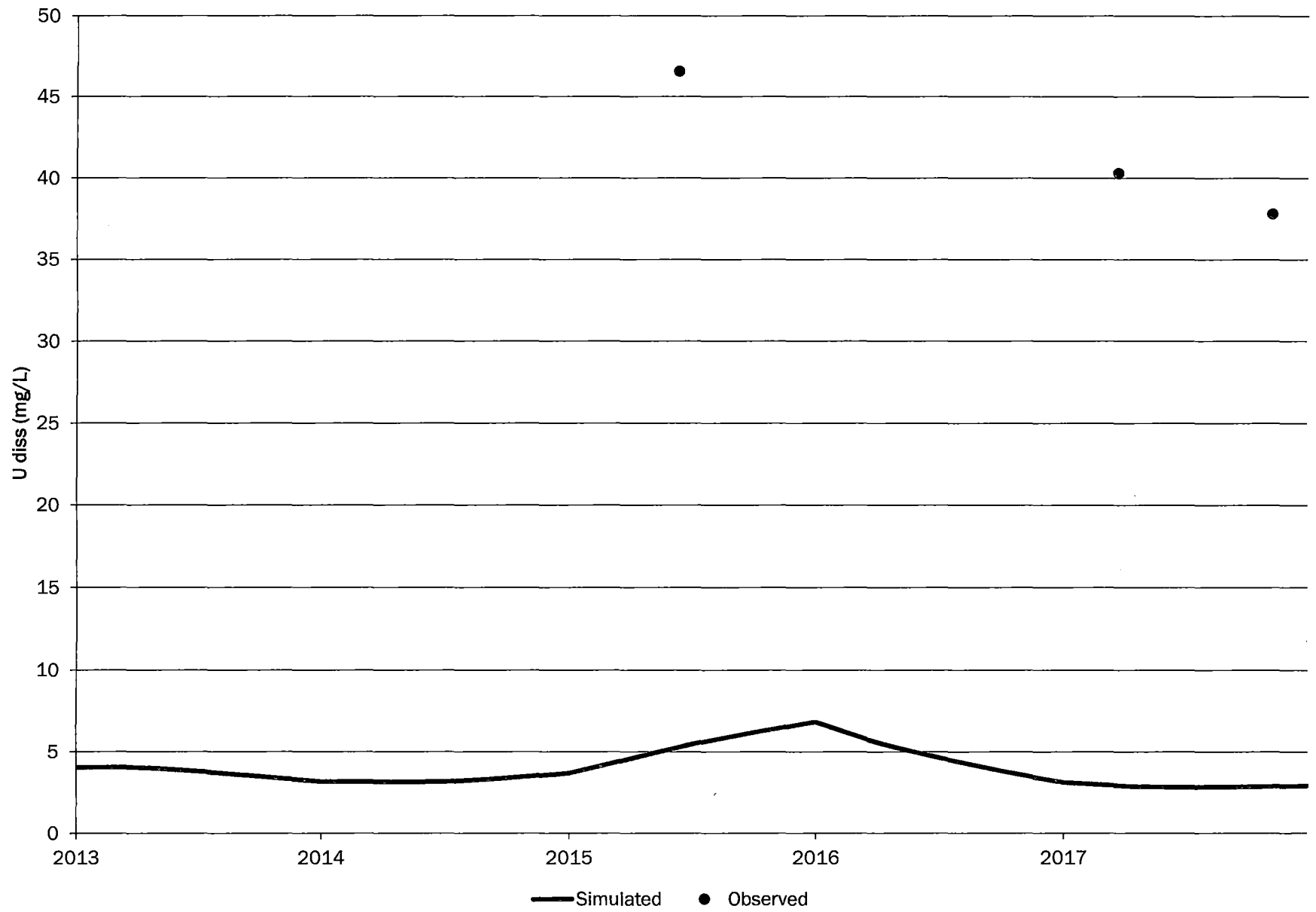
S12-AI



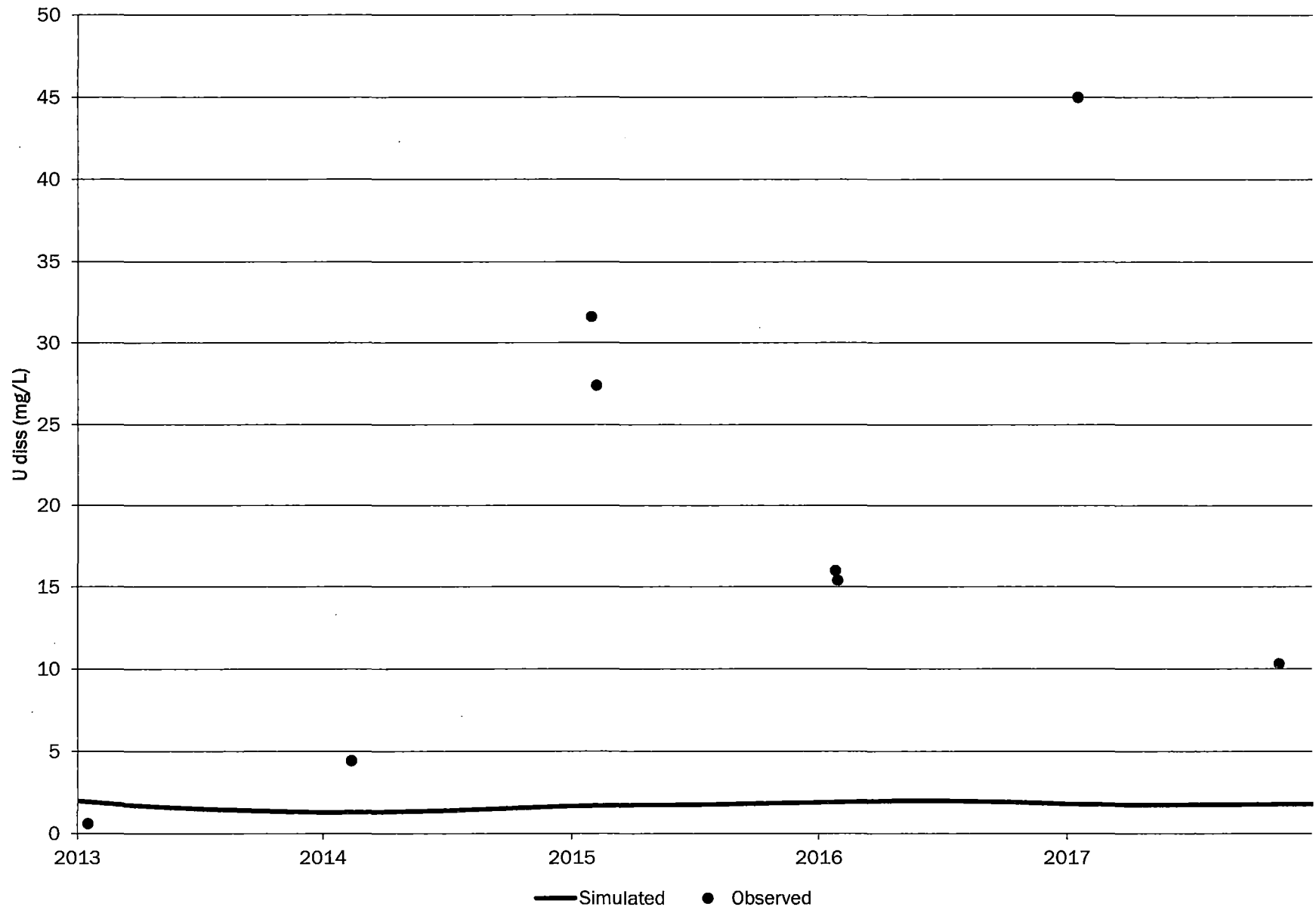
SA-AI



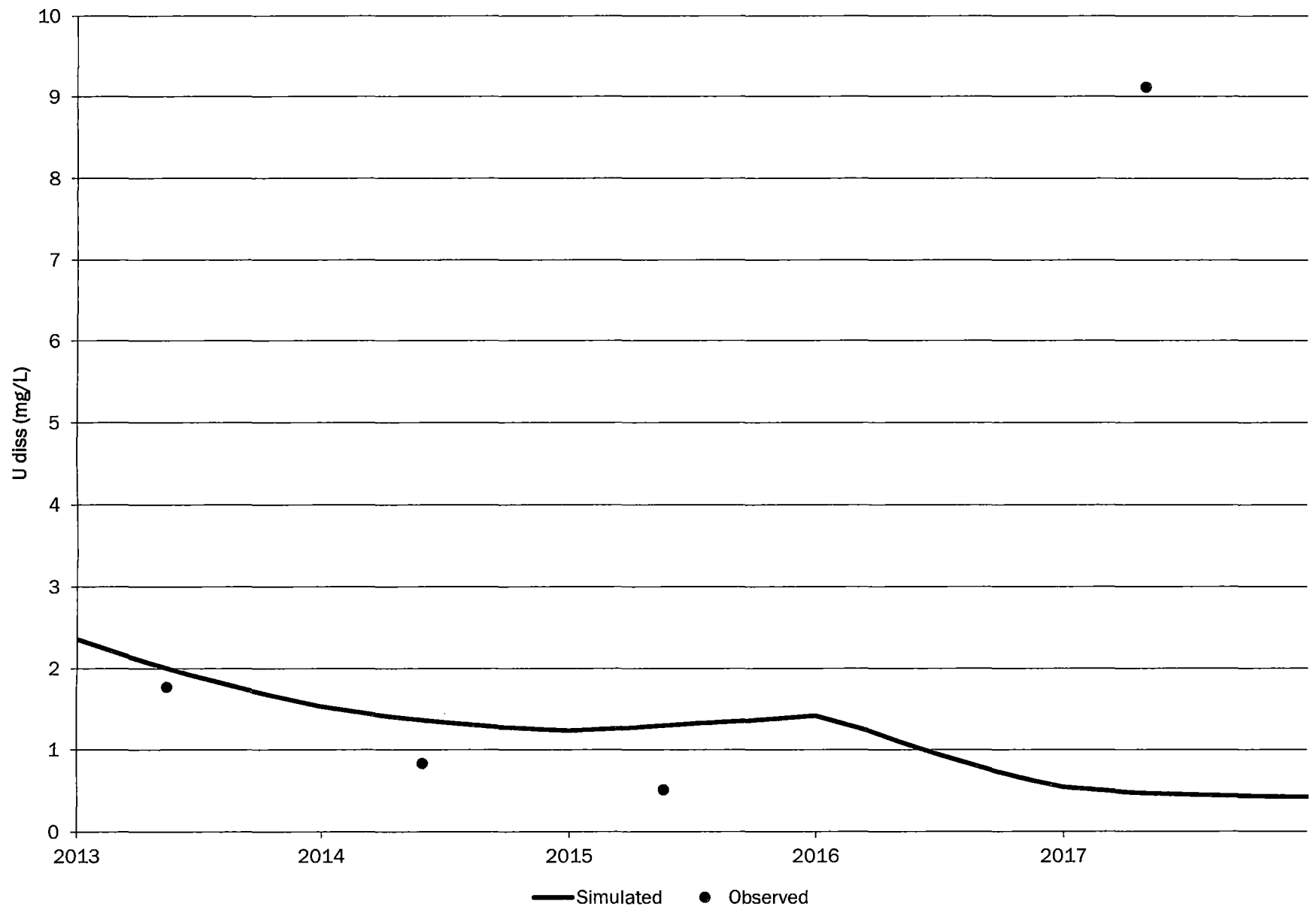
SB-AI



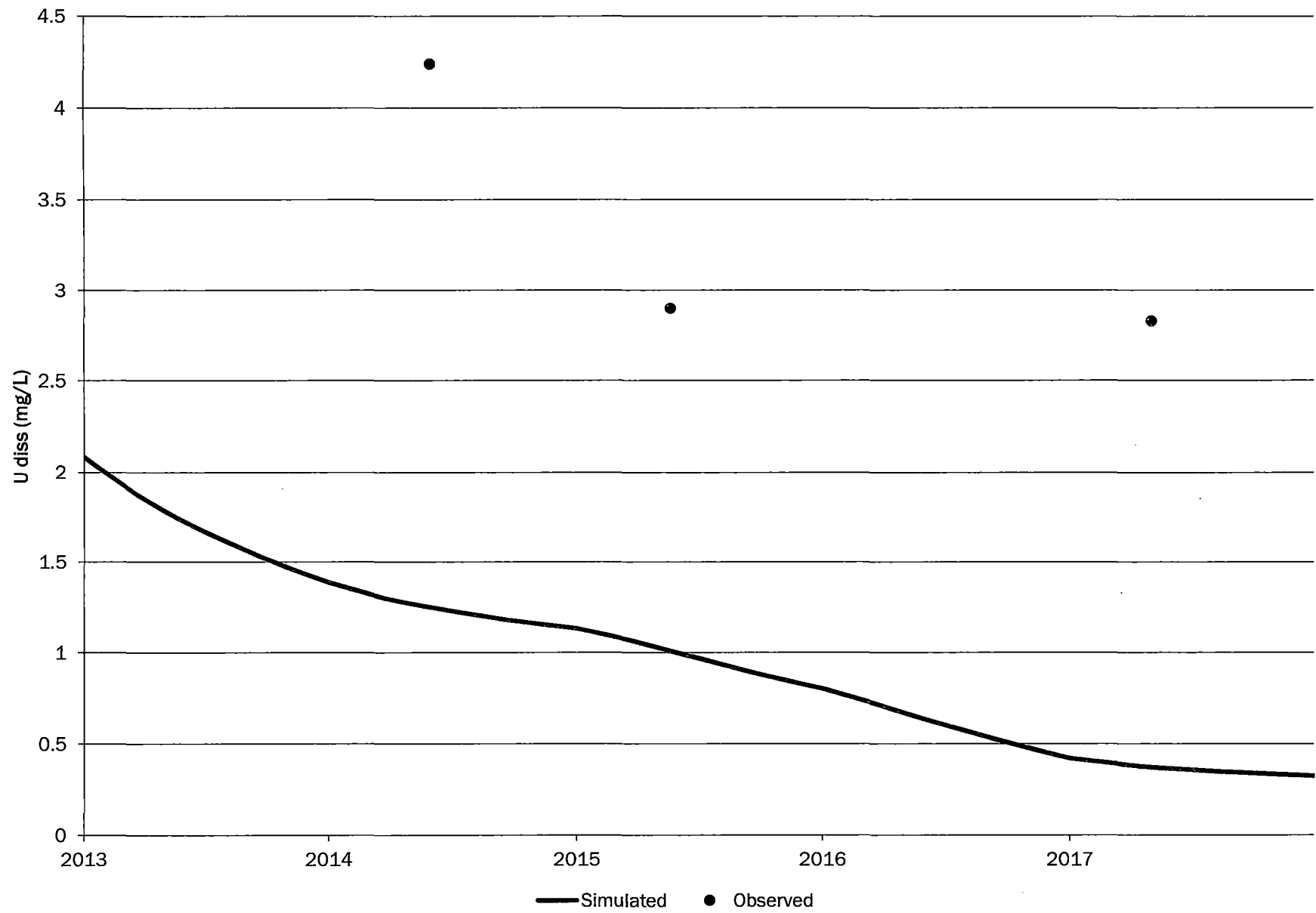
SE6-AI



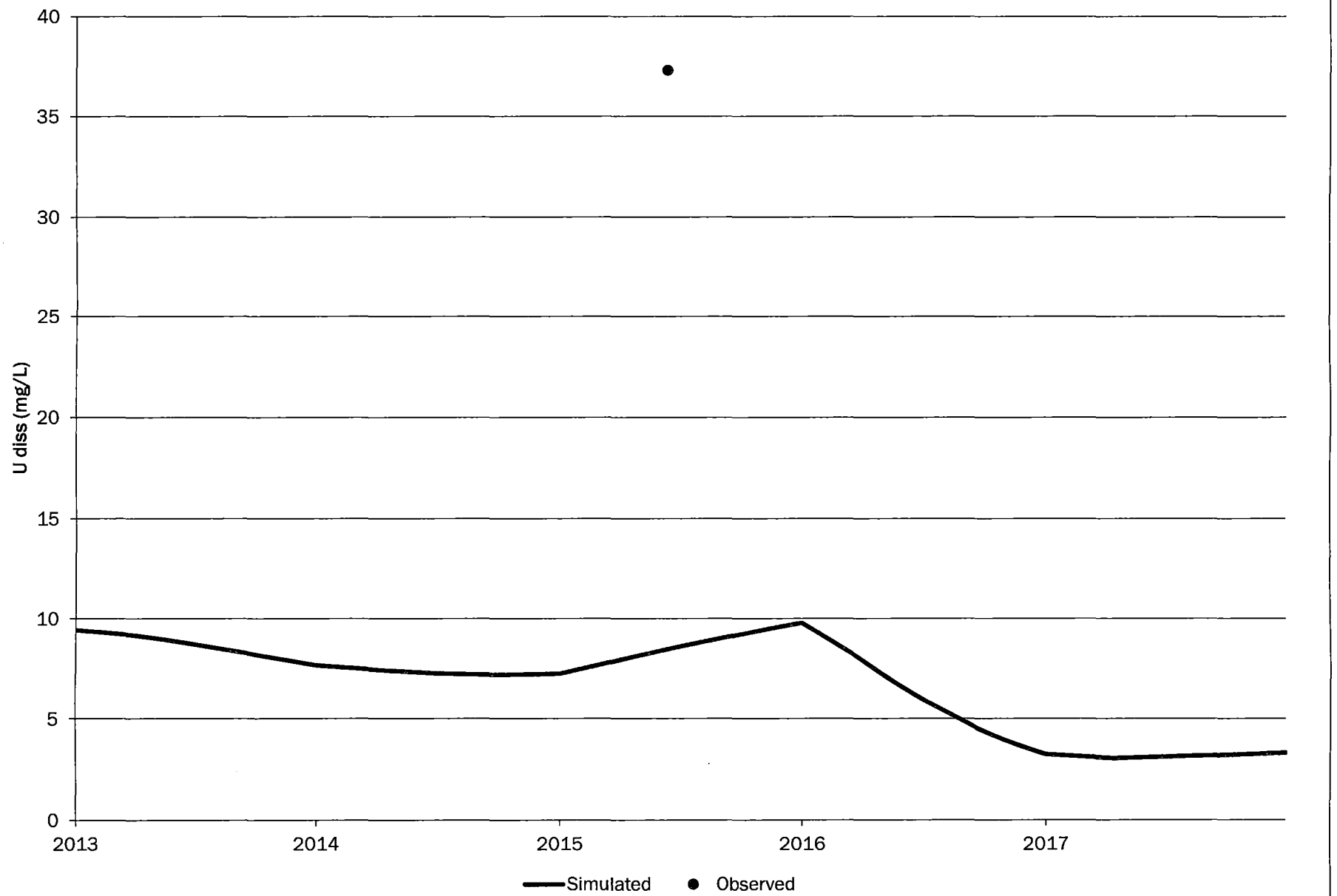
SM-AI



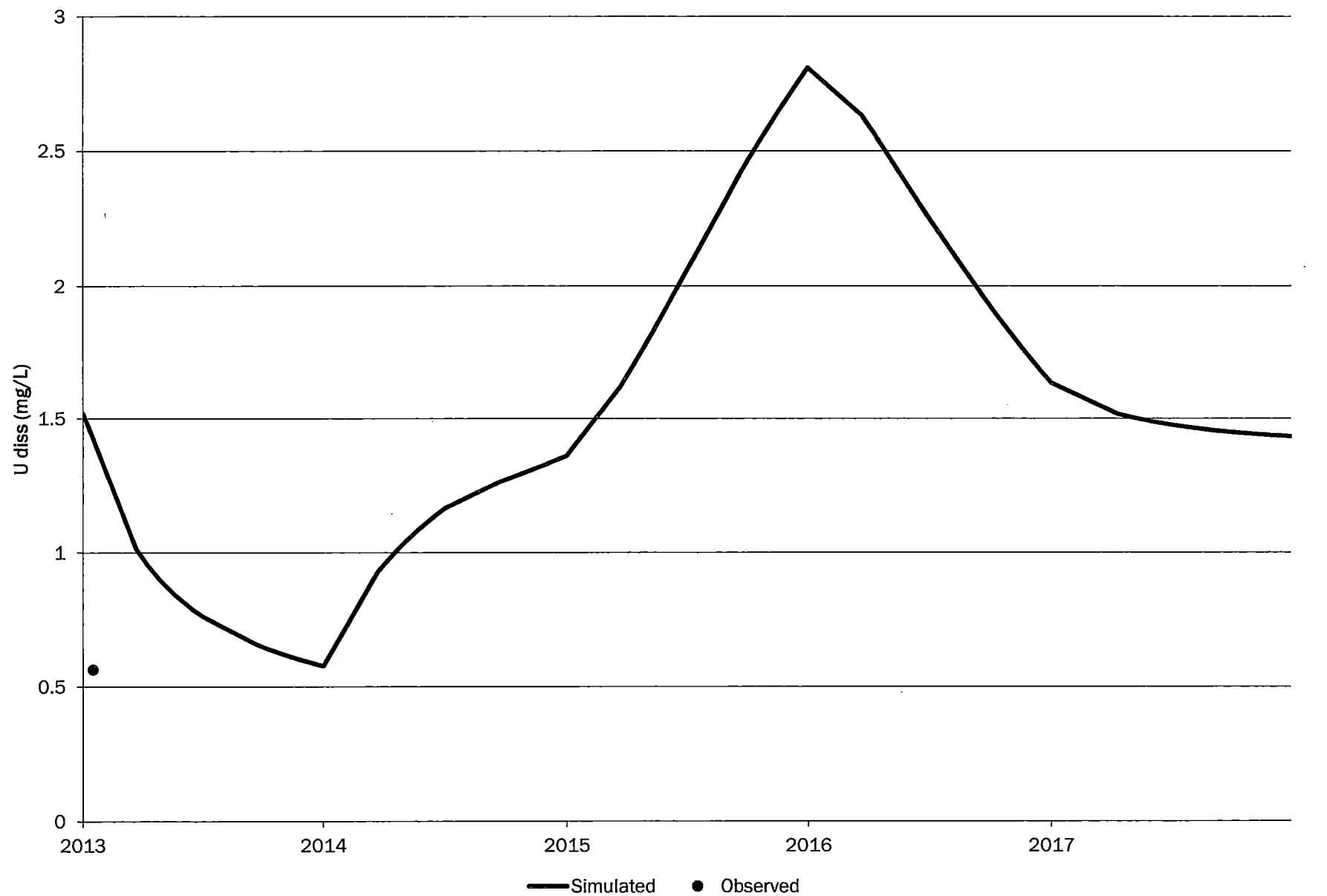
SO-AI



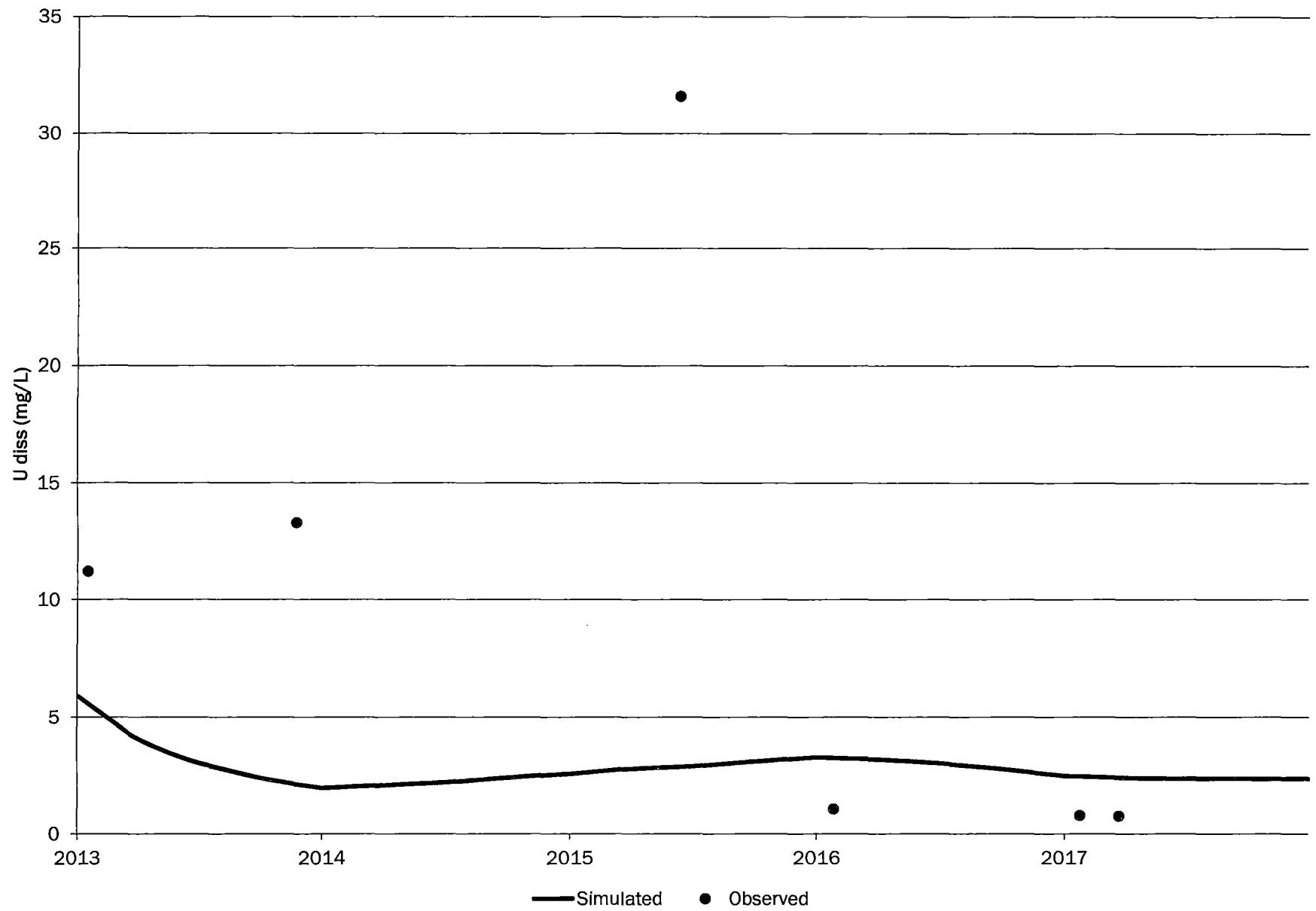
SQ-AI



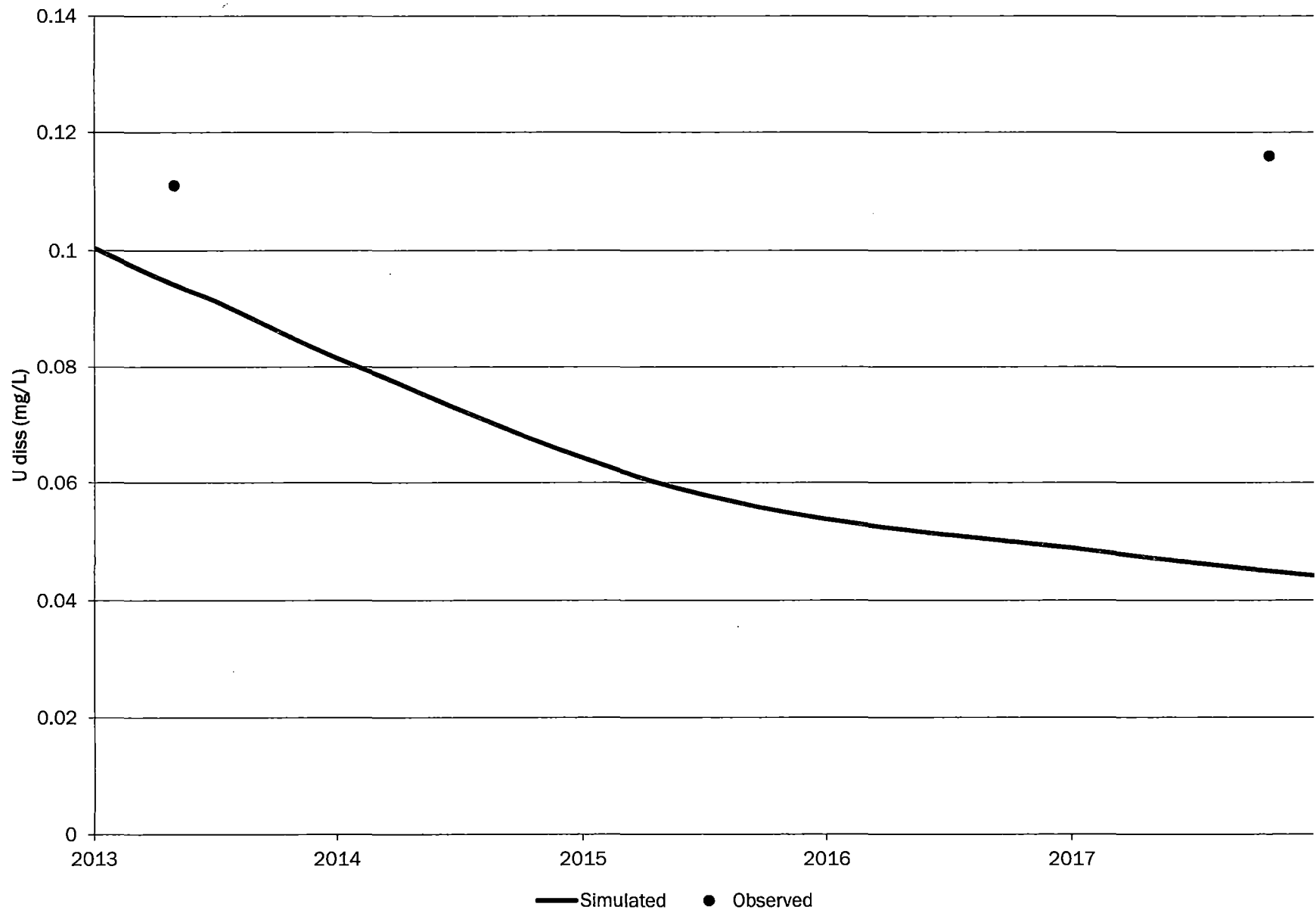
SS-AI



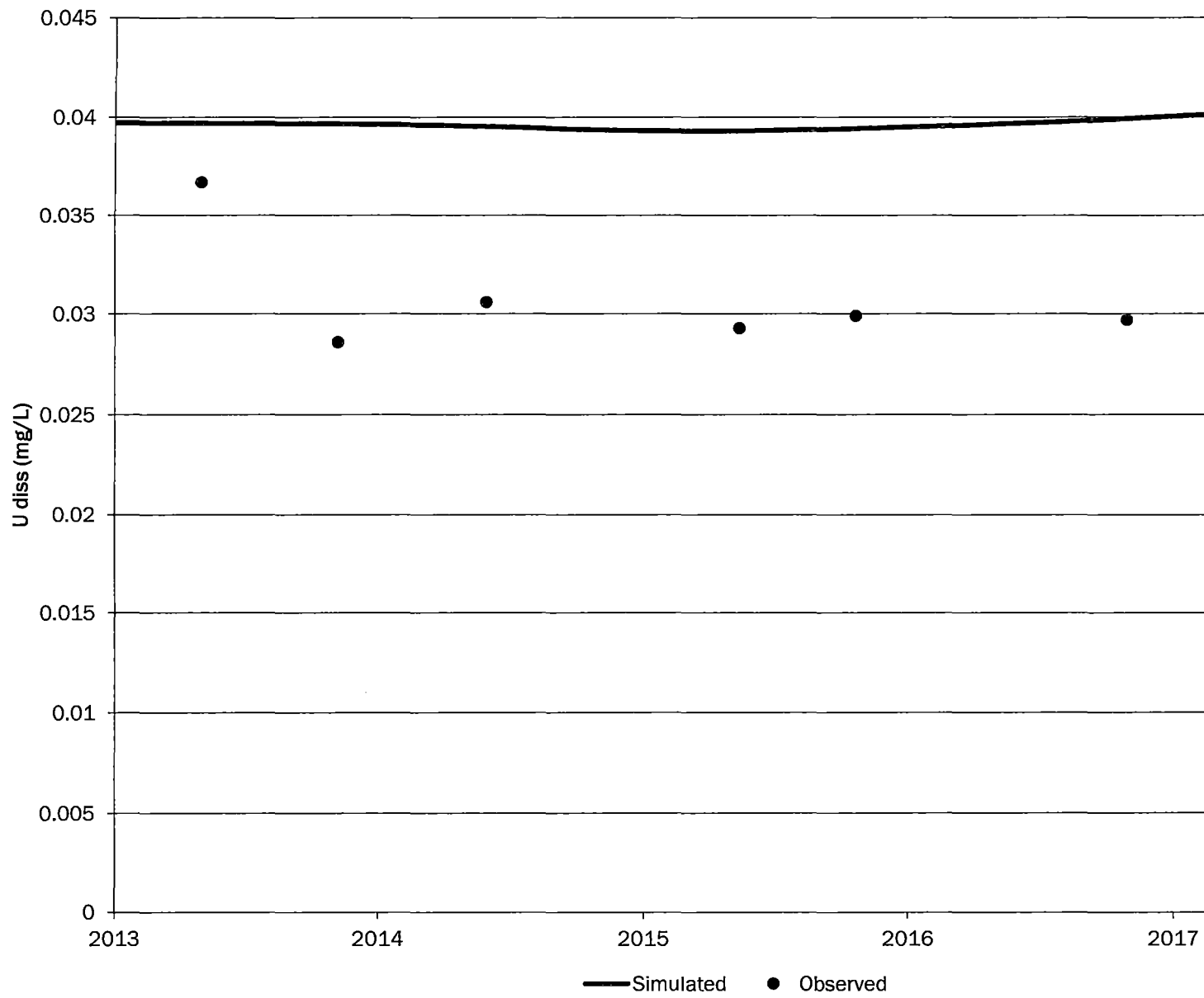
ST-AI



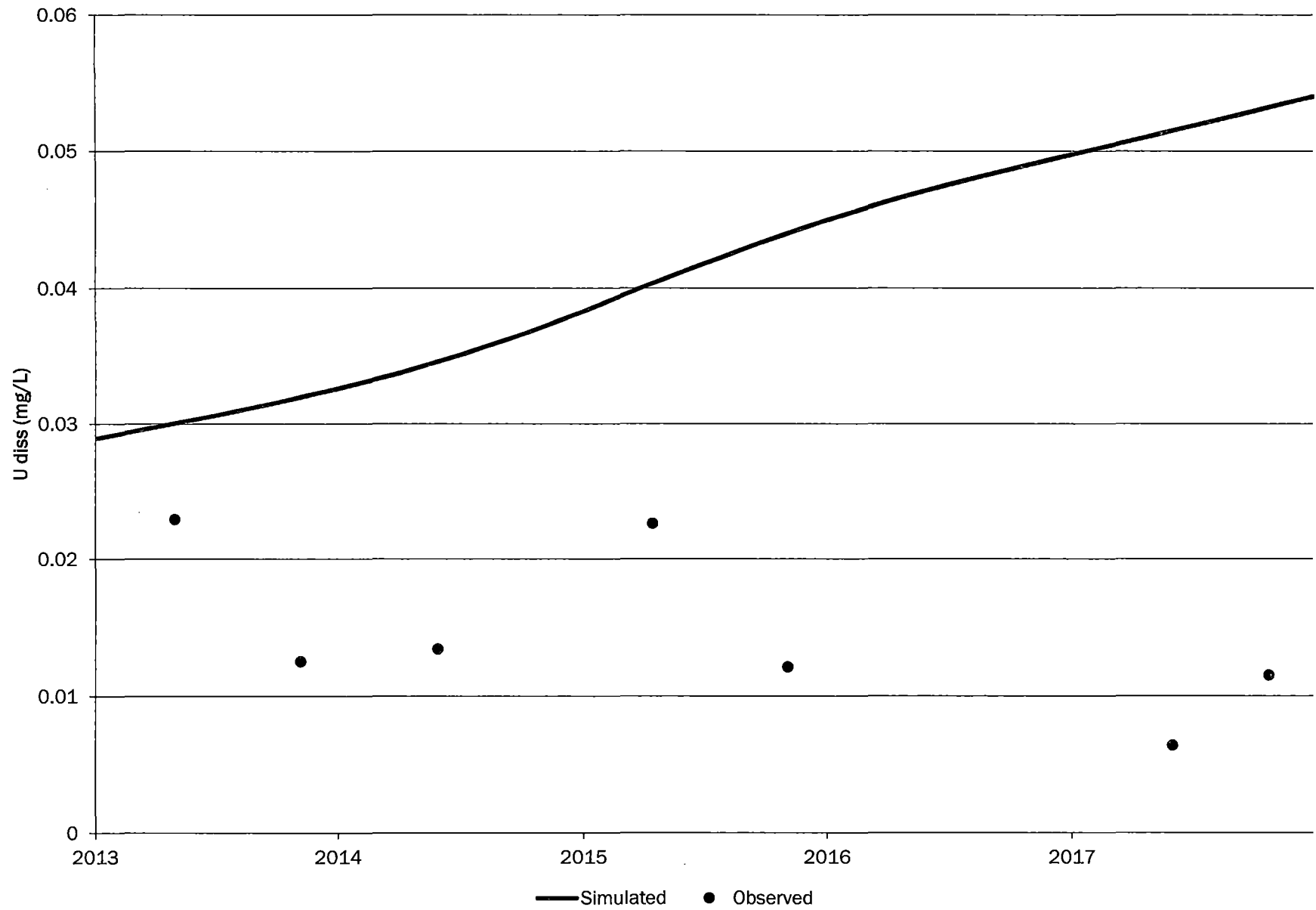
SUB1-AI



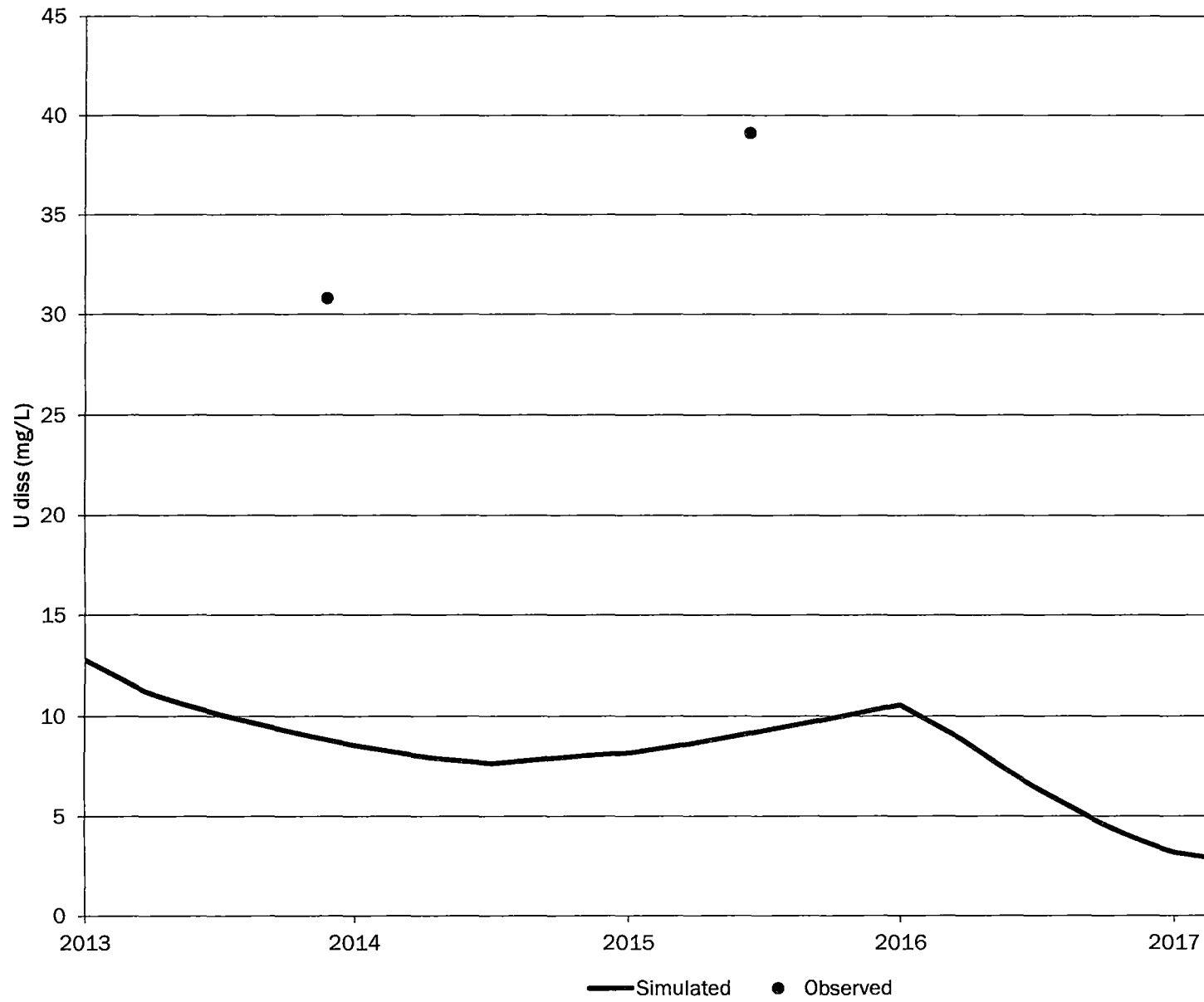
SUB2-AI



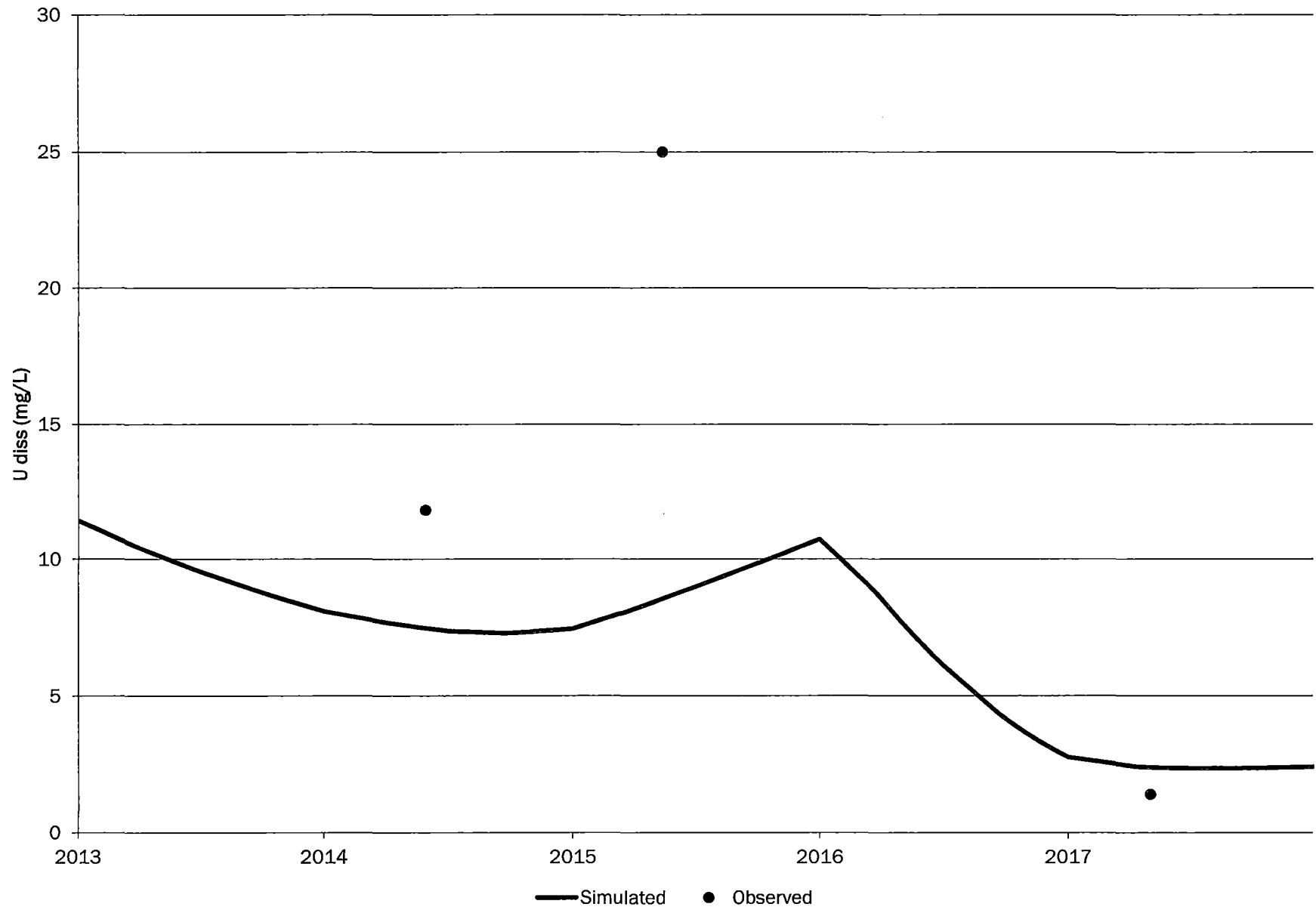
SUB3-AI



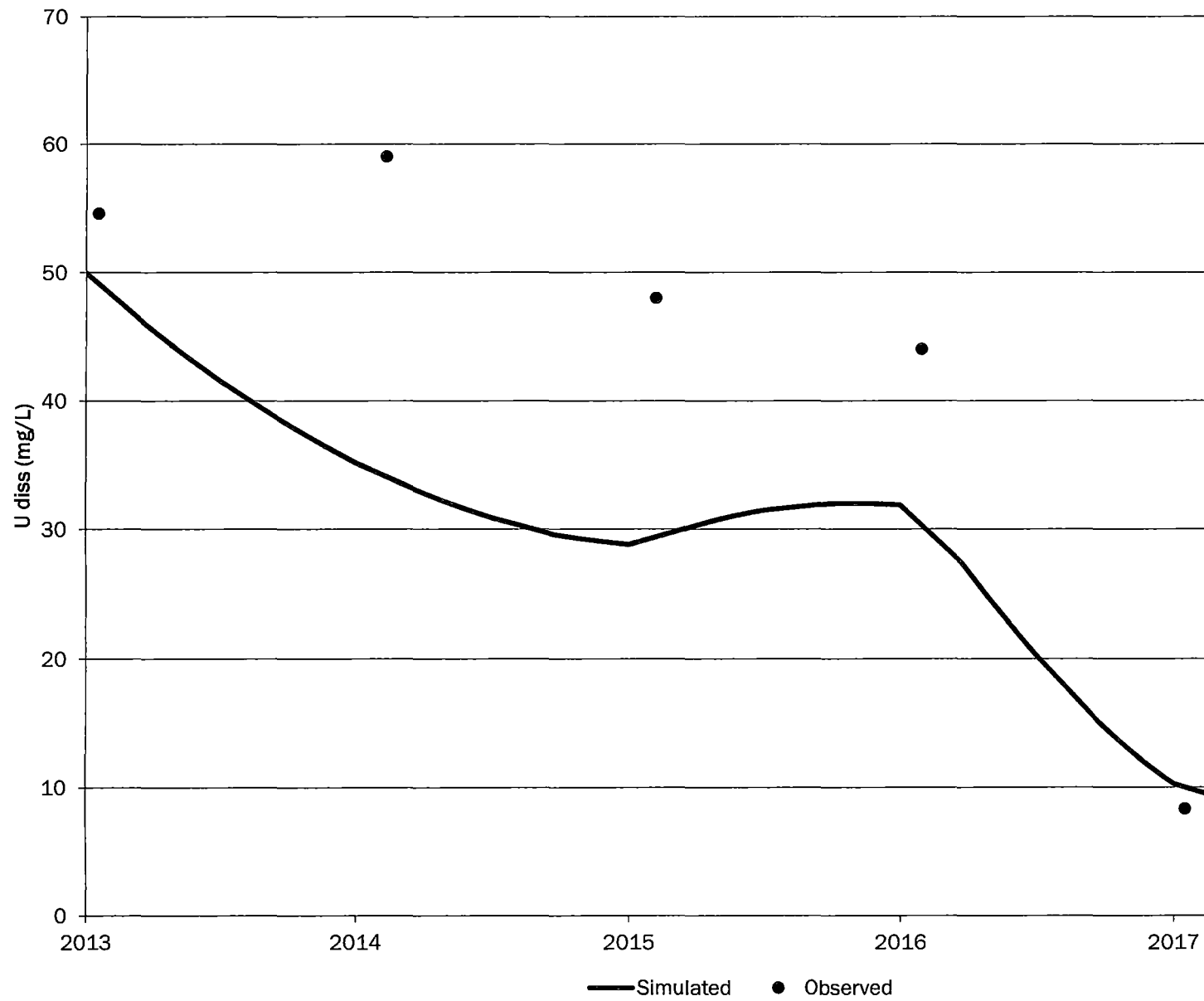
SV-AI



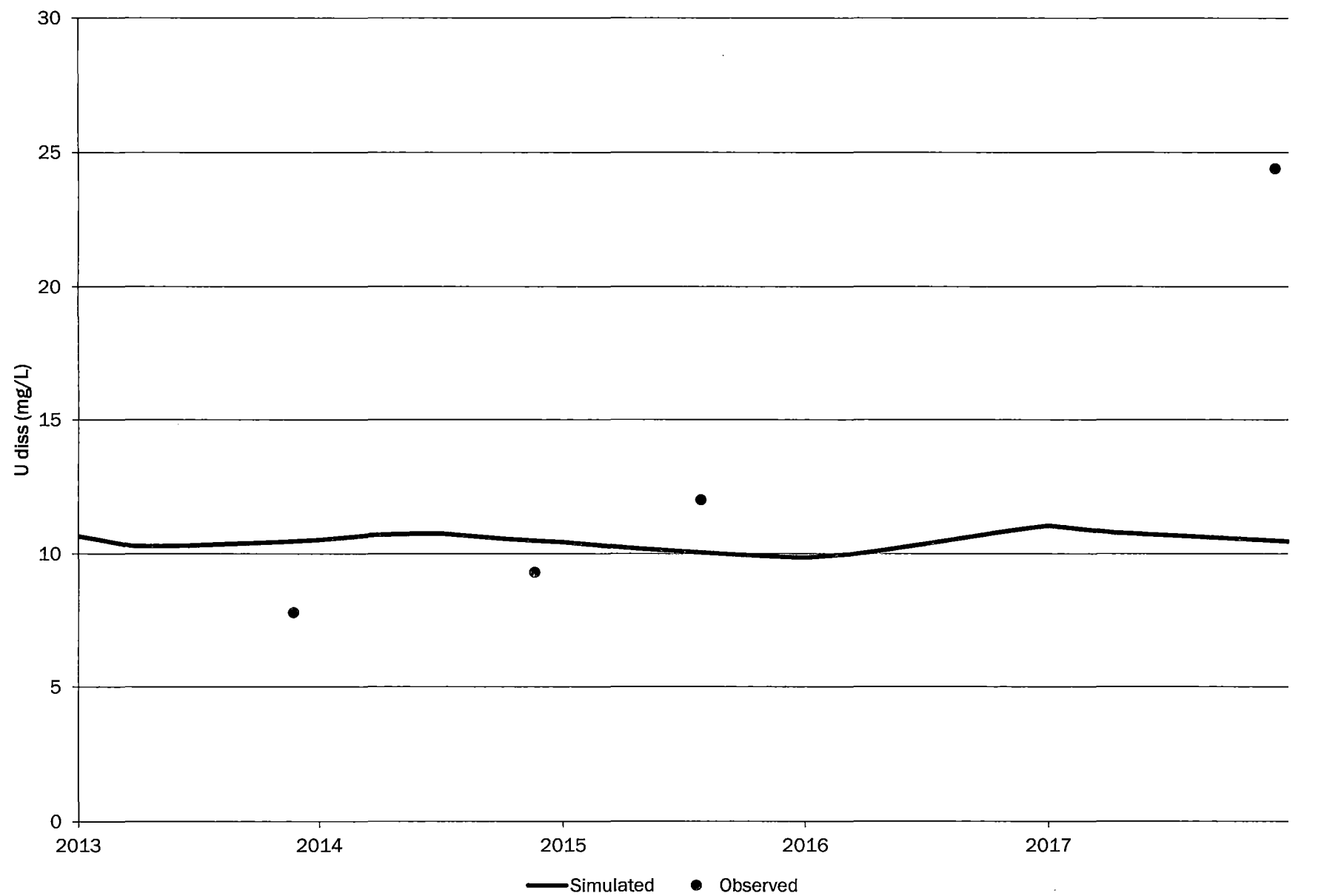
SW-AI



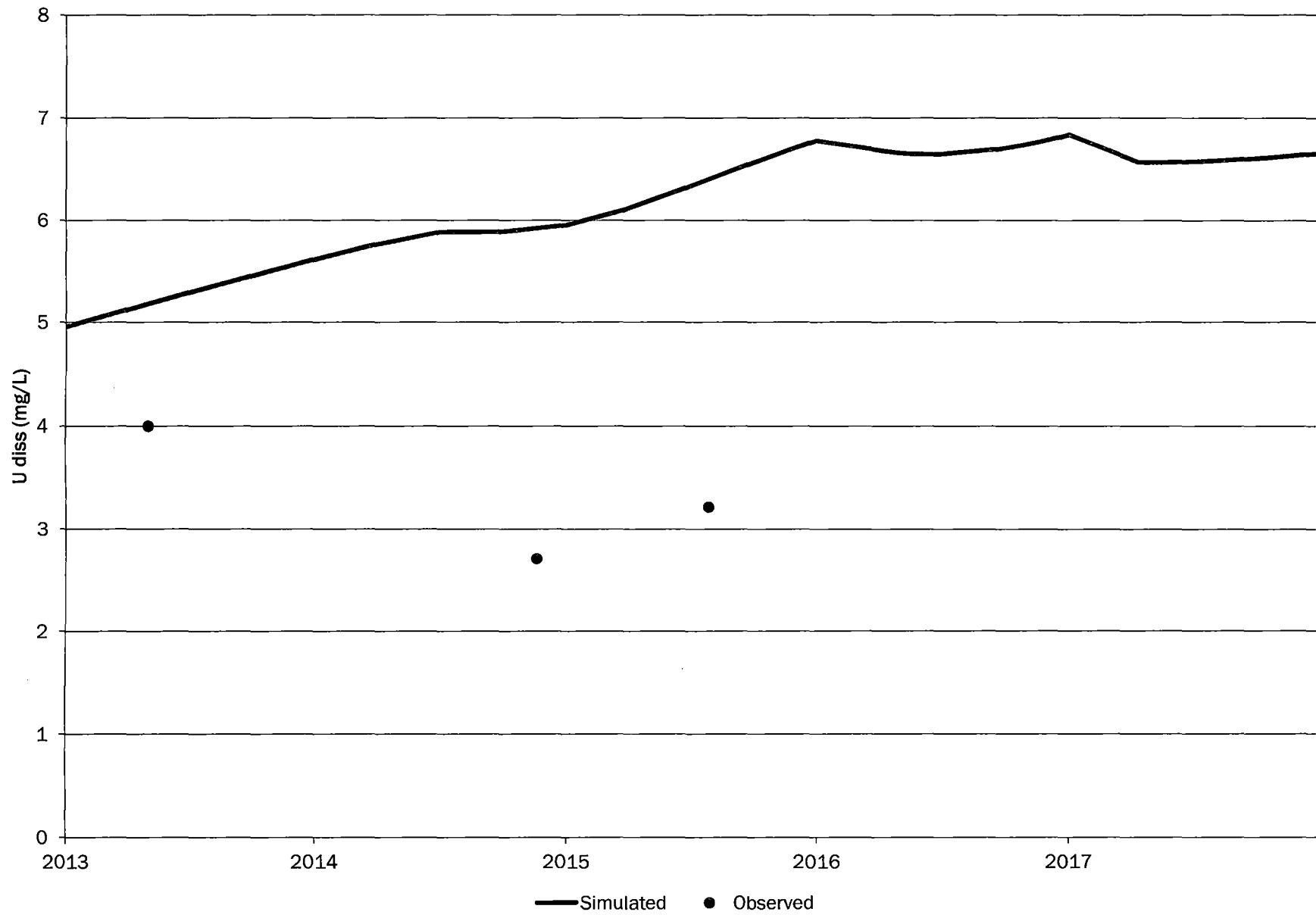
SZ-AI



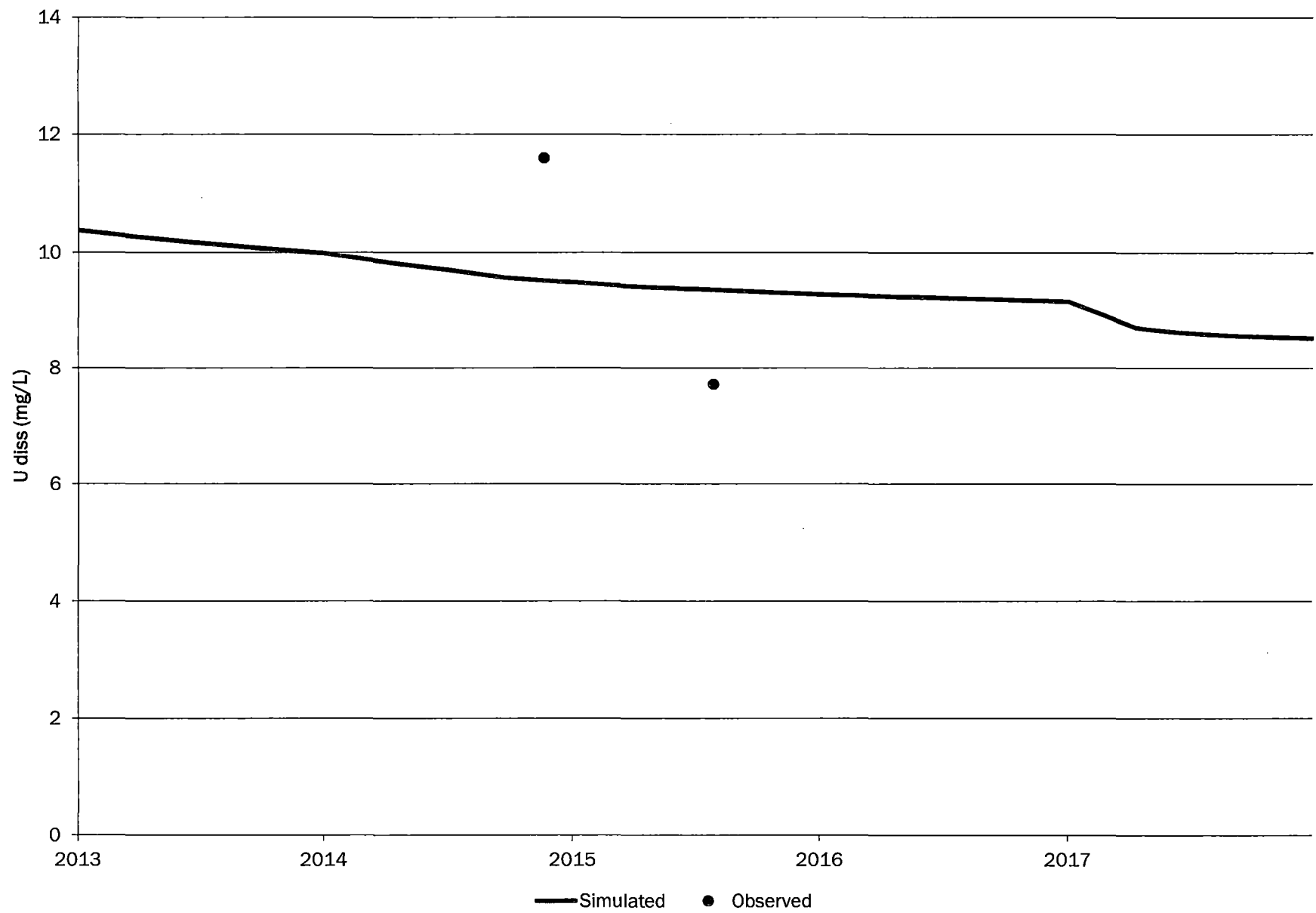
T2-AI



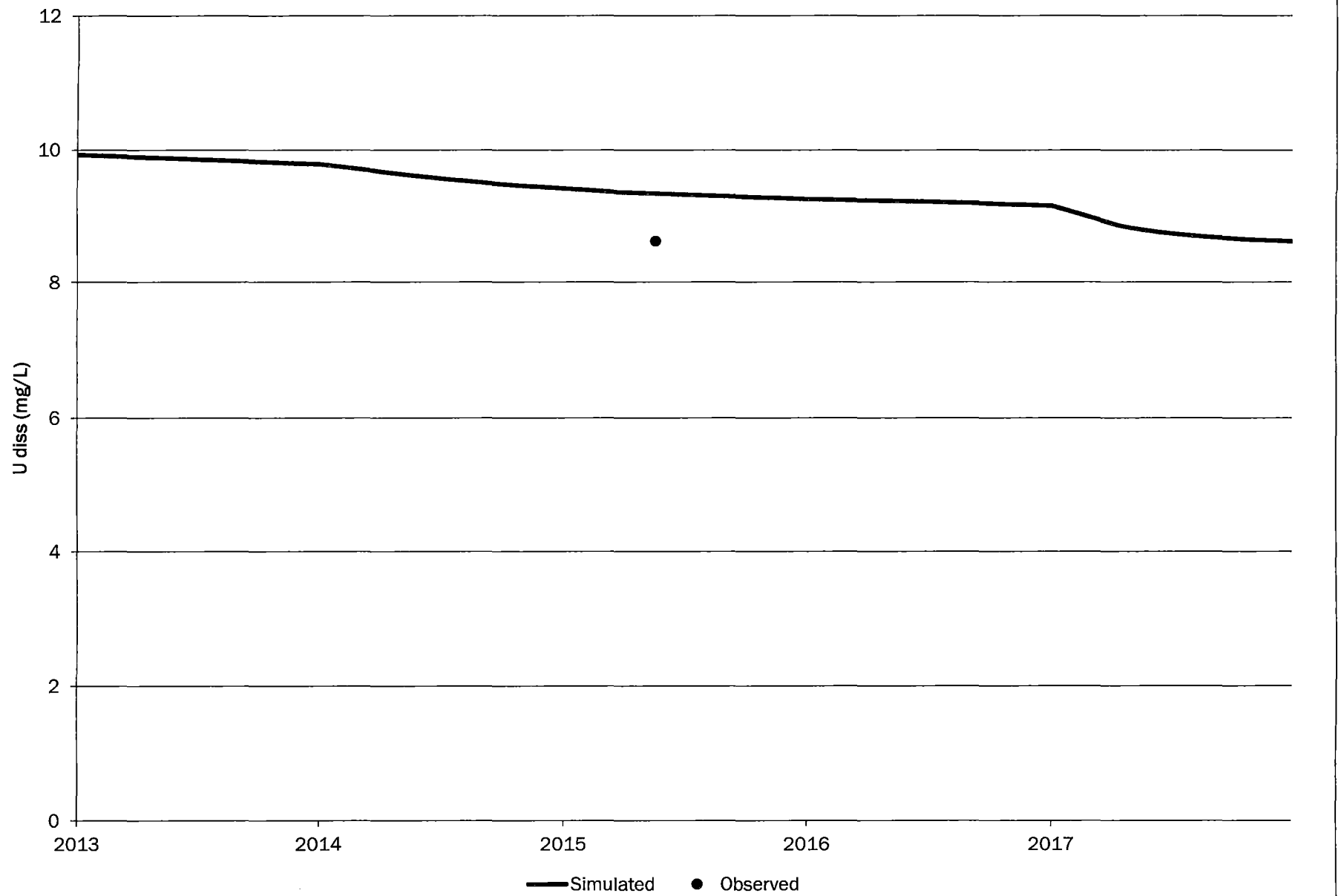
T4-AI



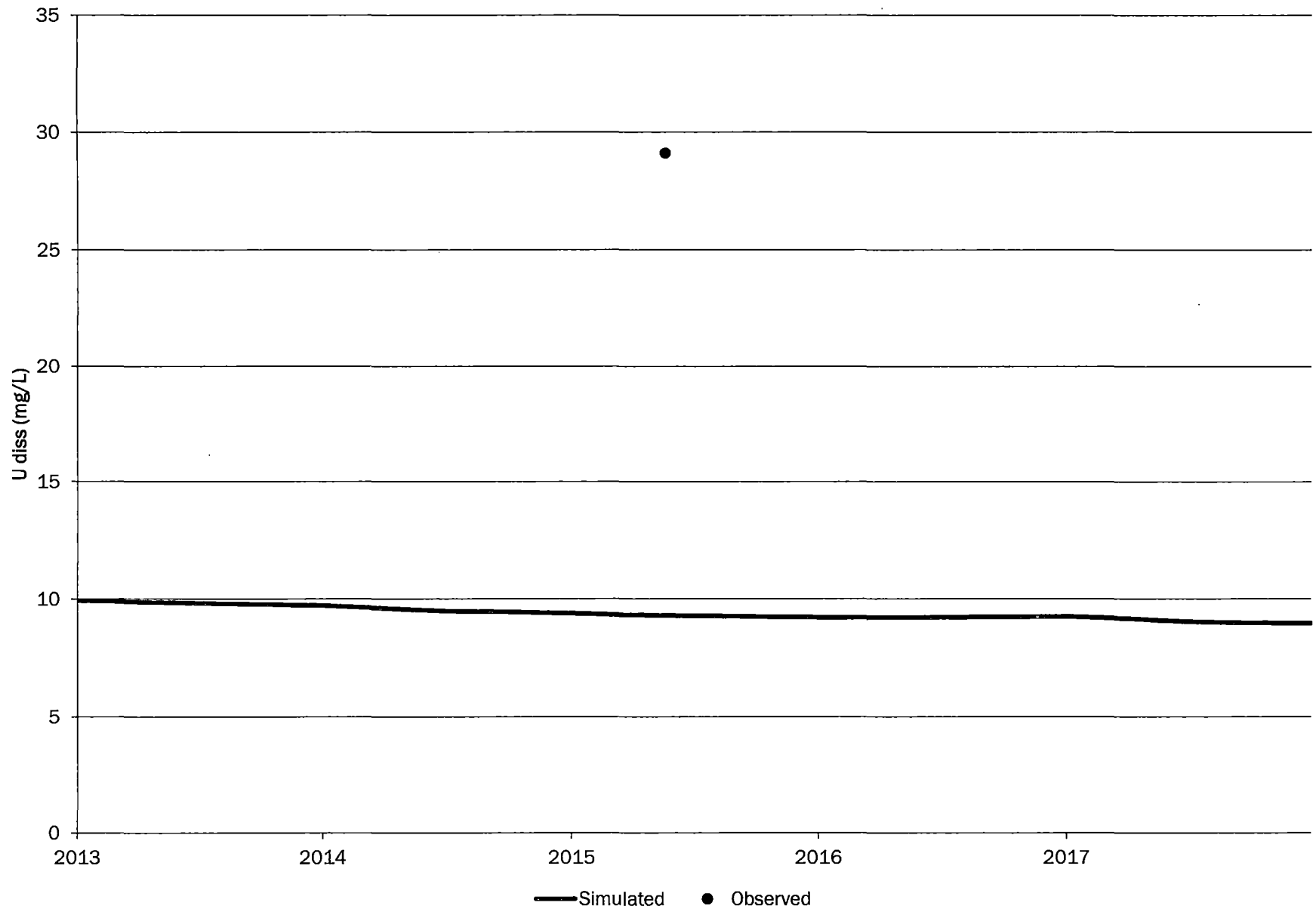
T5-AI



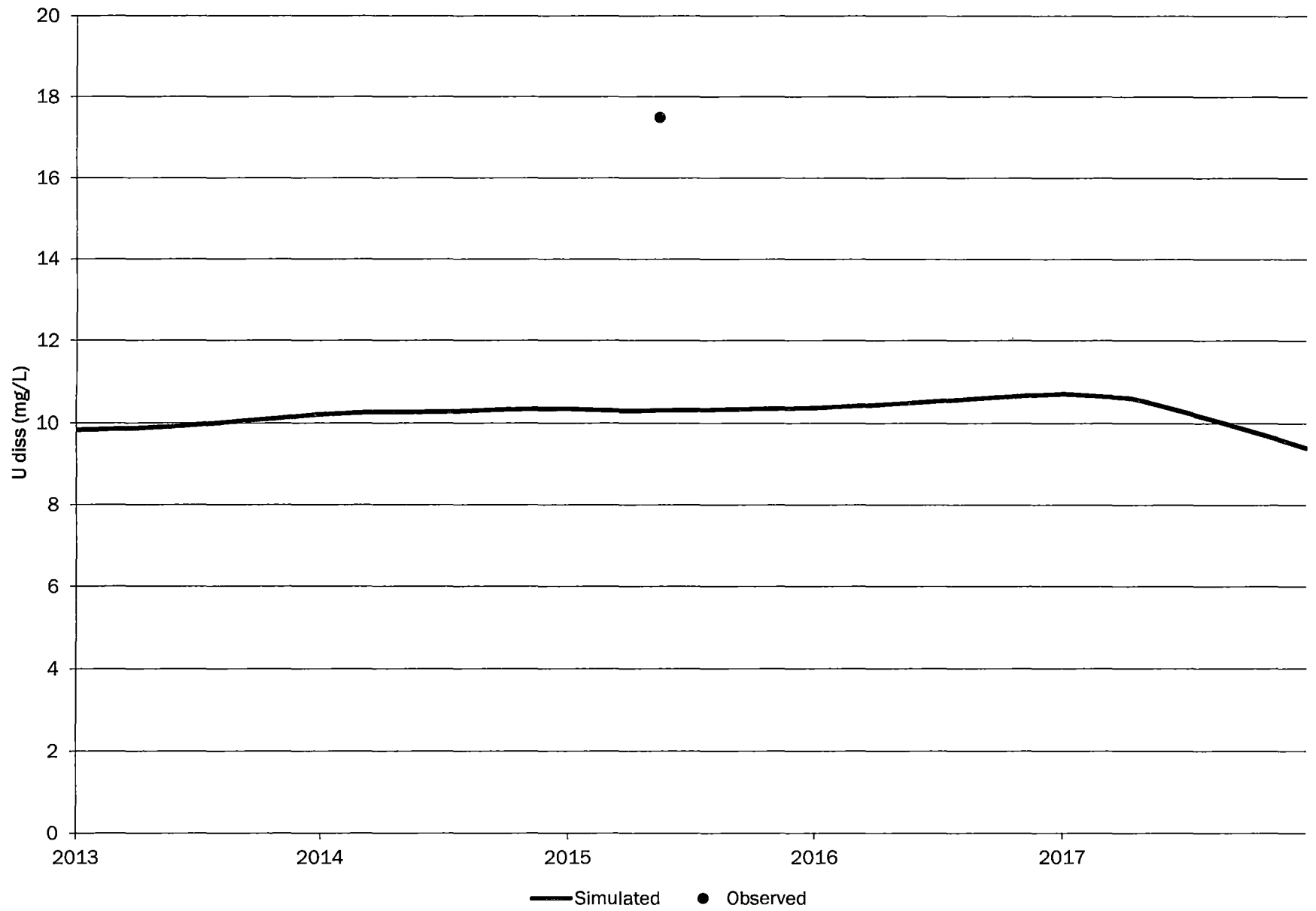
T6-AI



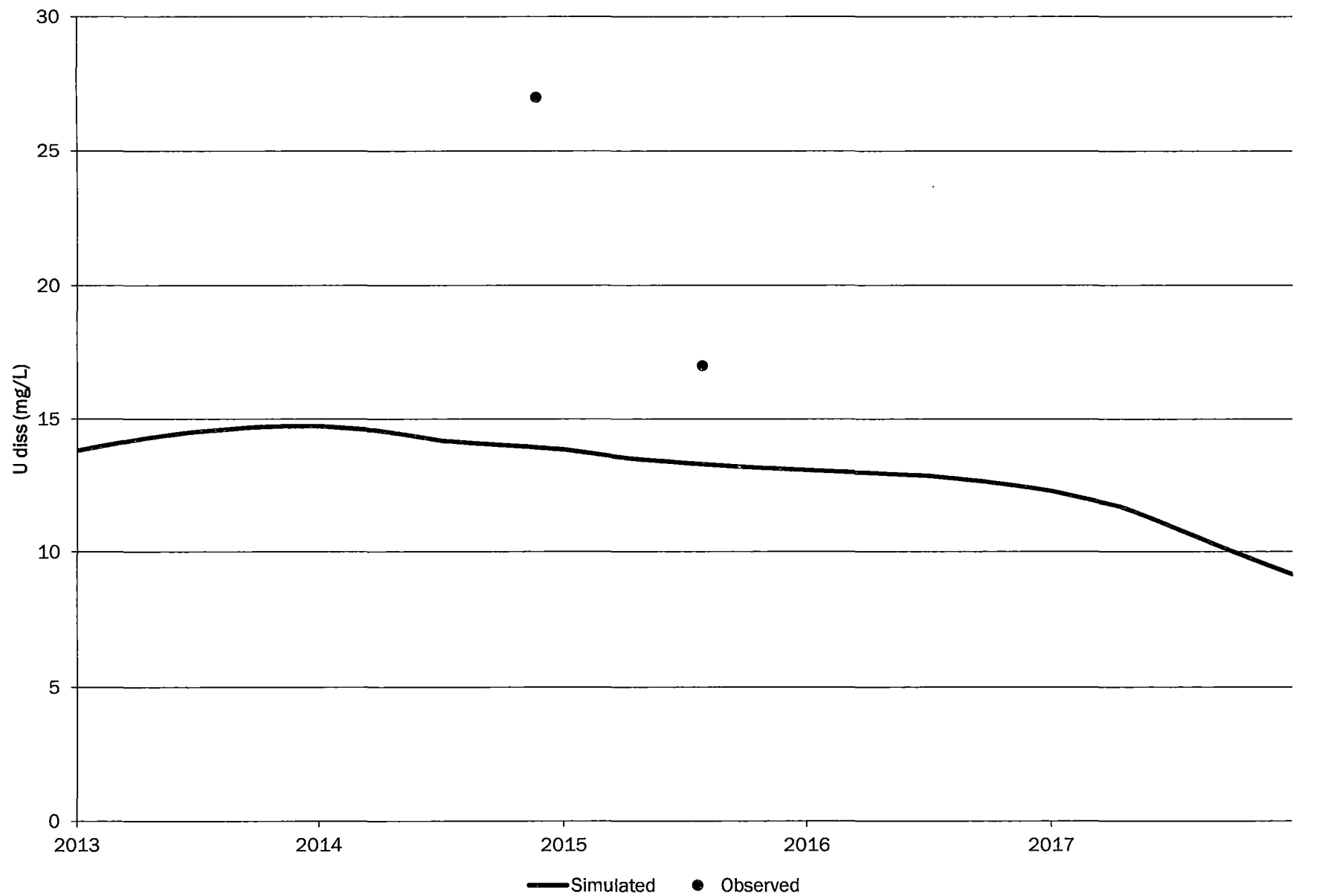
T7-AI



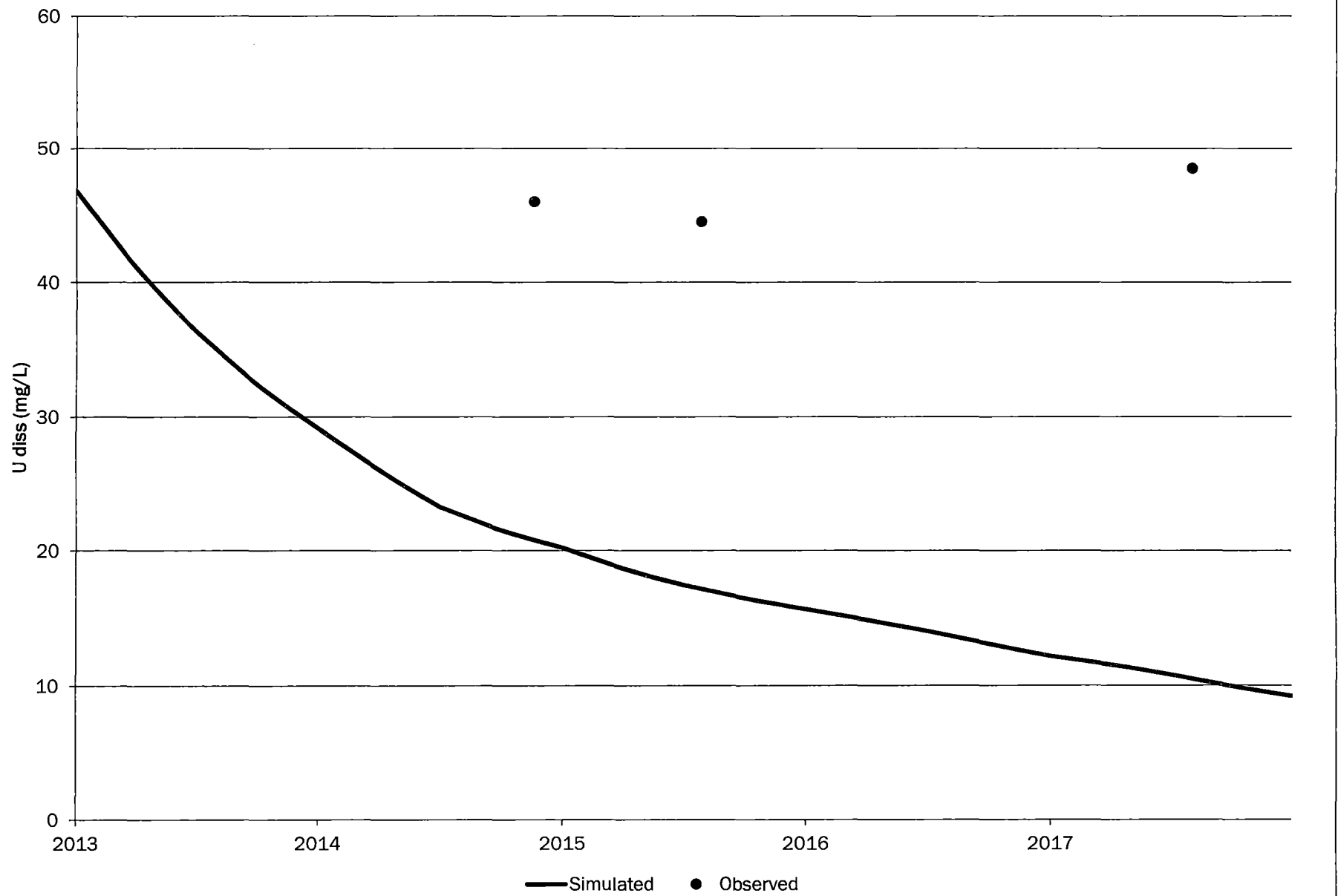
T8-AI



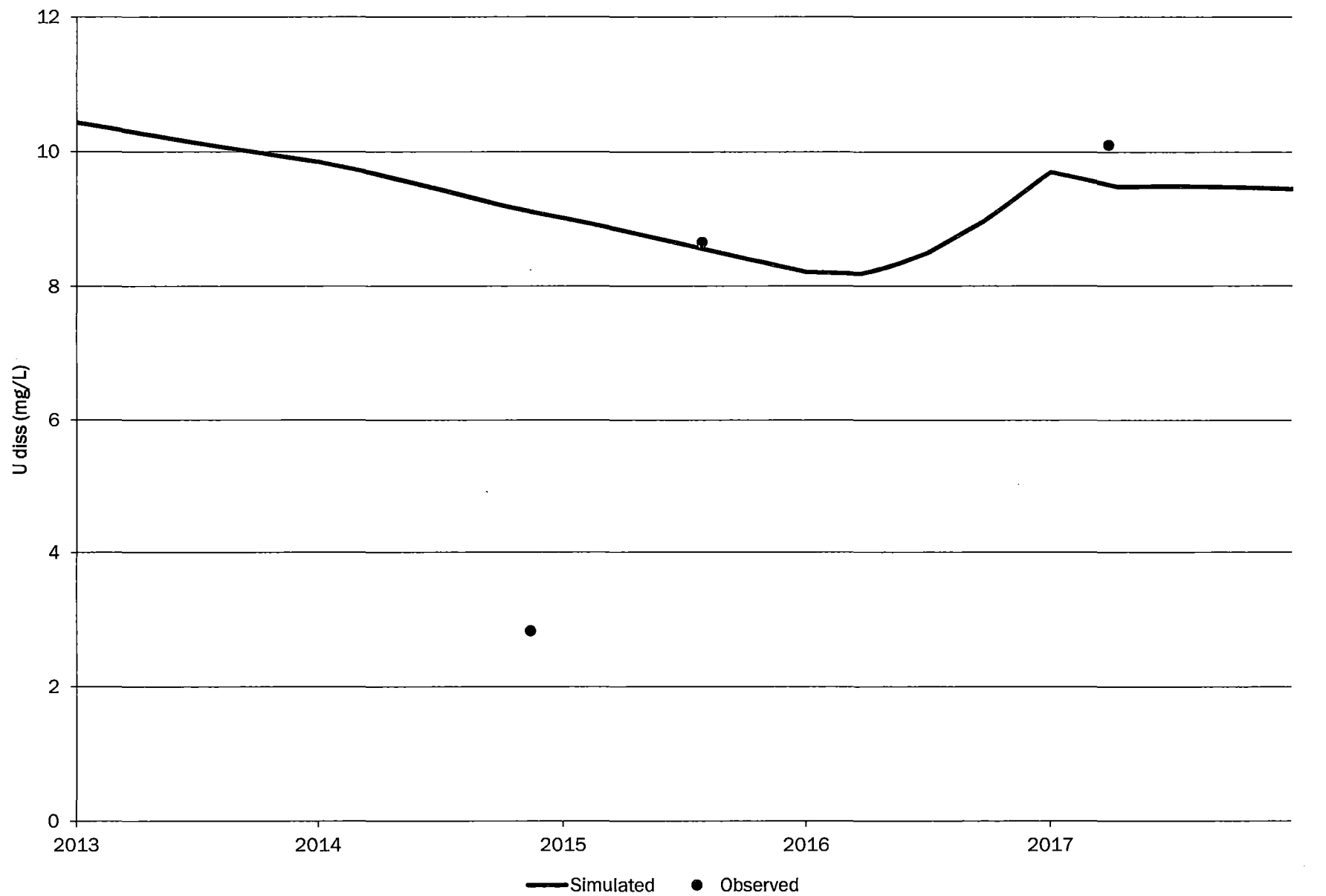
T9-AI



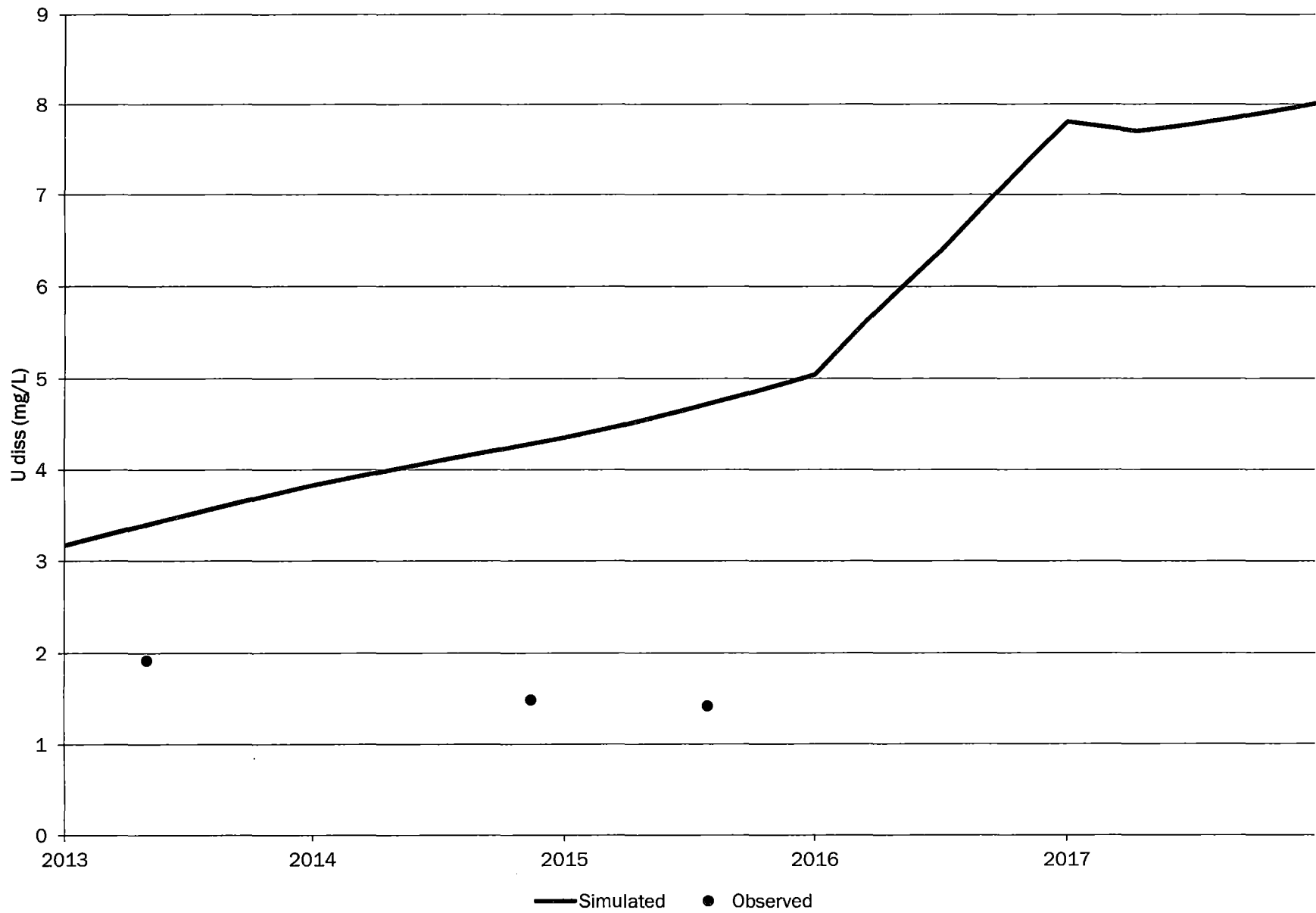
T10-AI



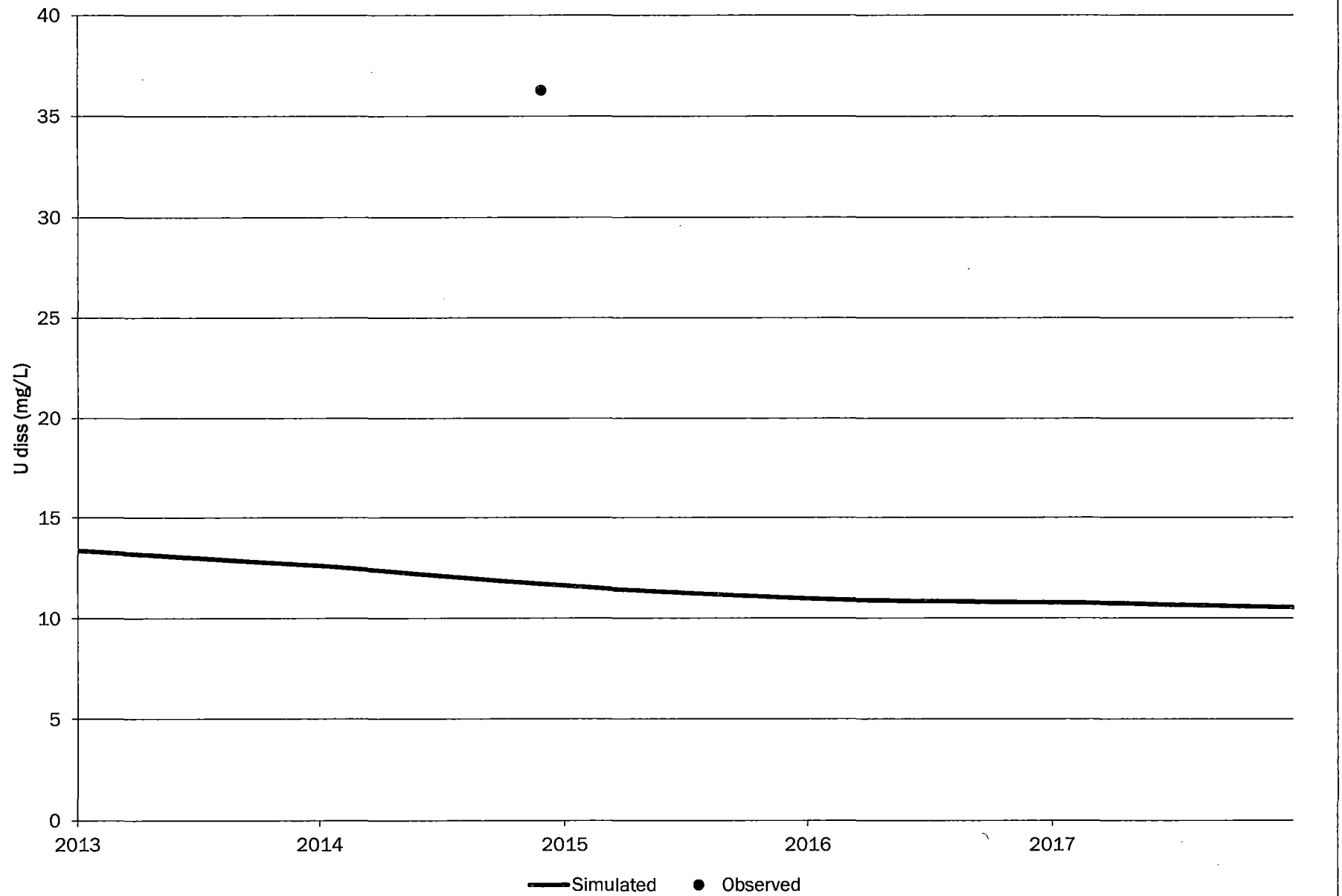
T11-AI



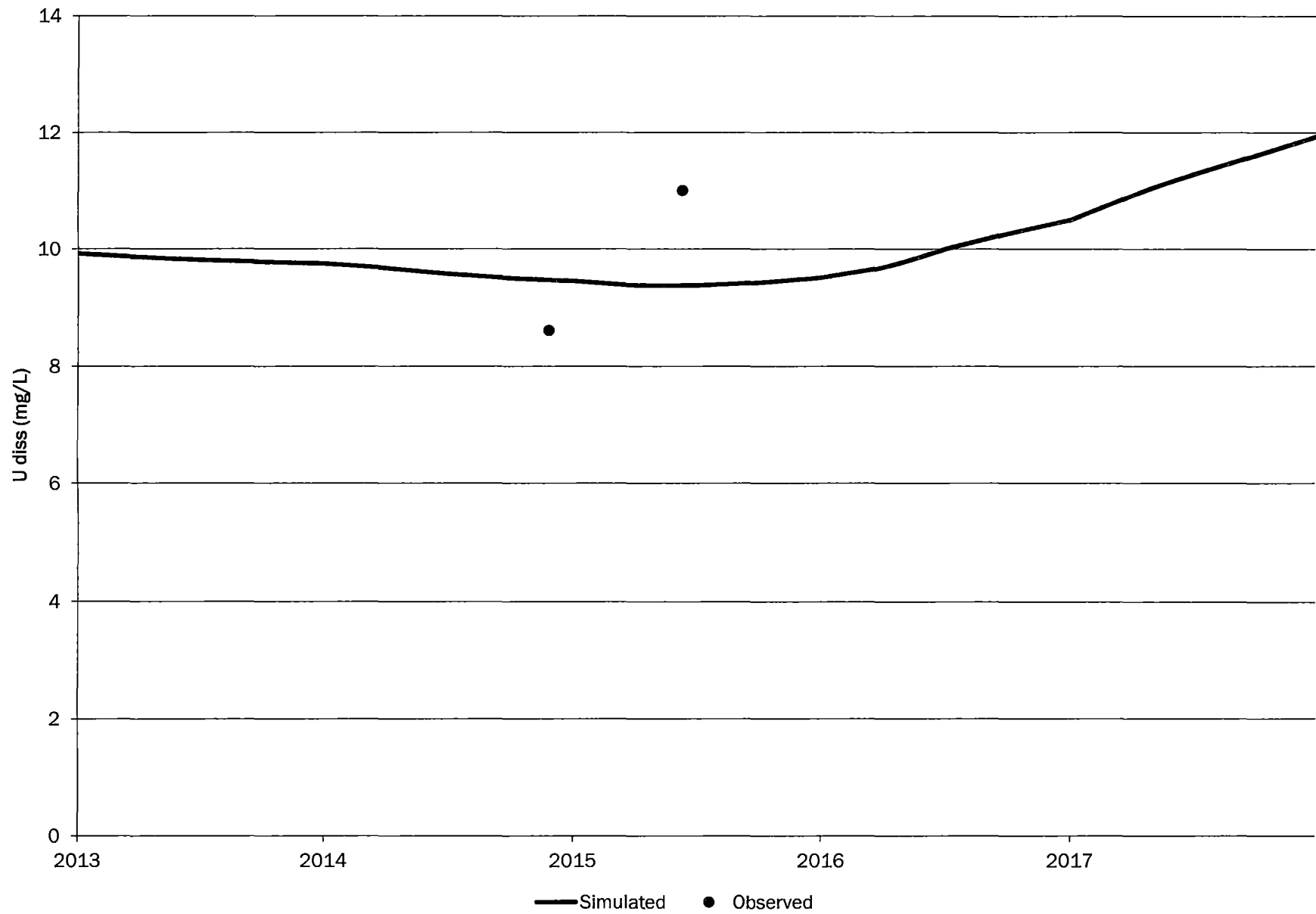
T12-AI



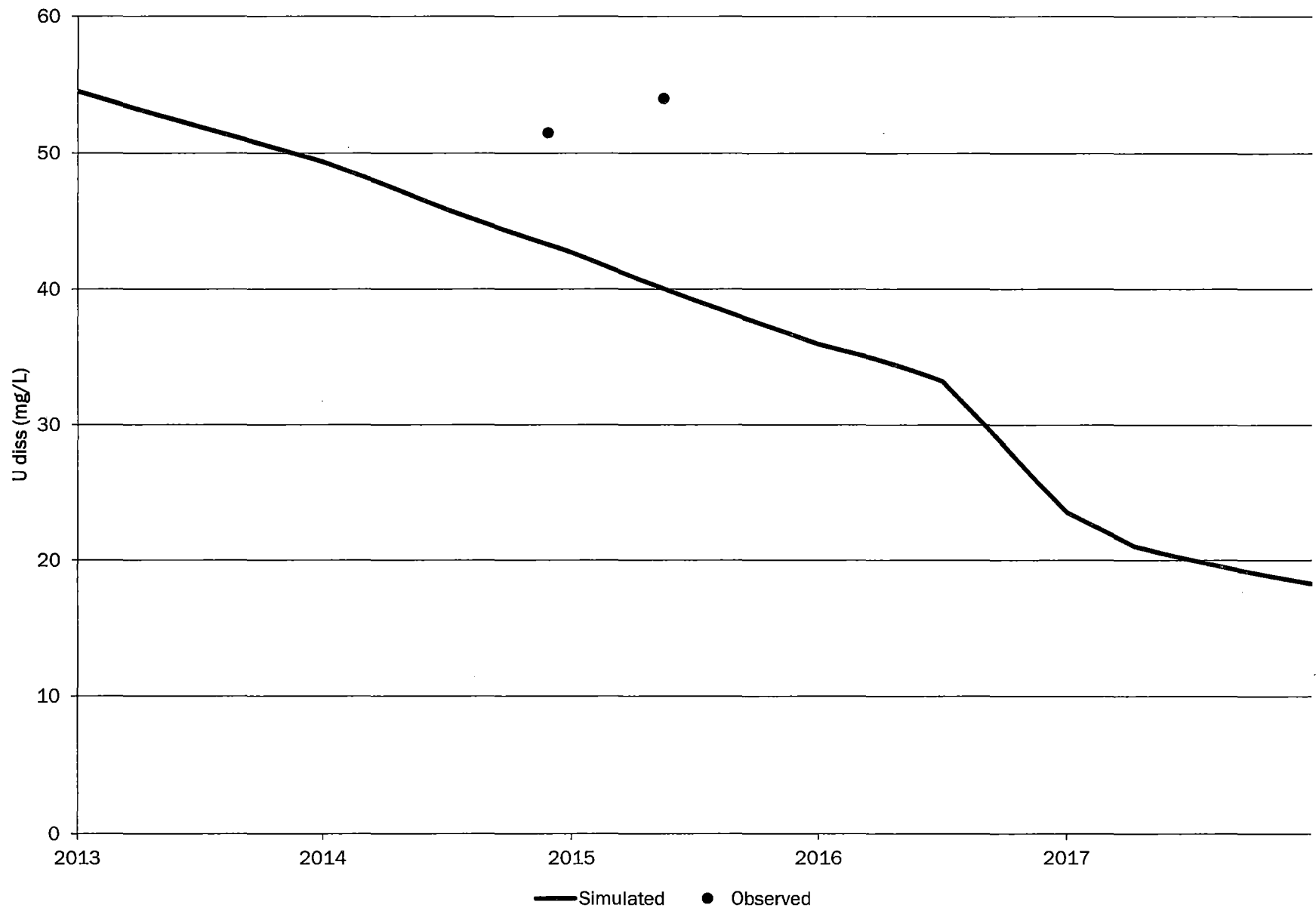
T14-AI



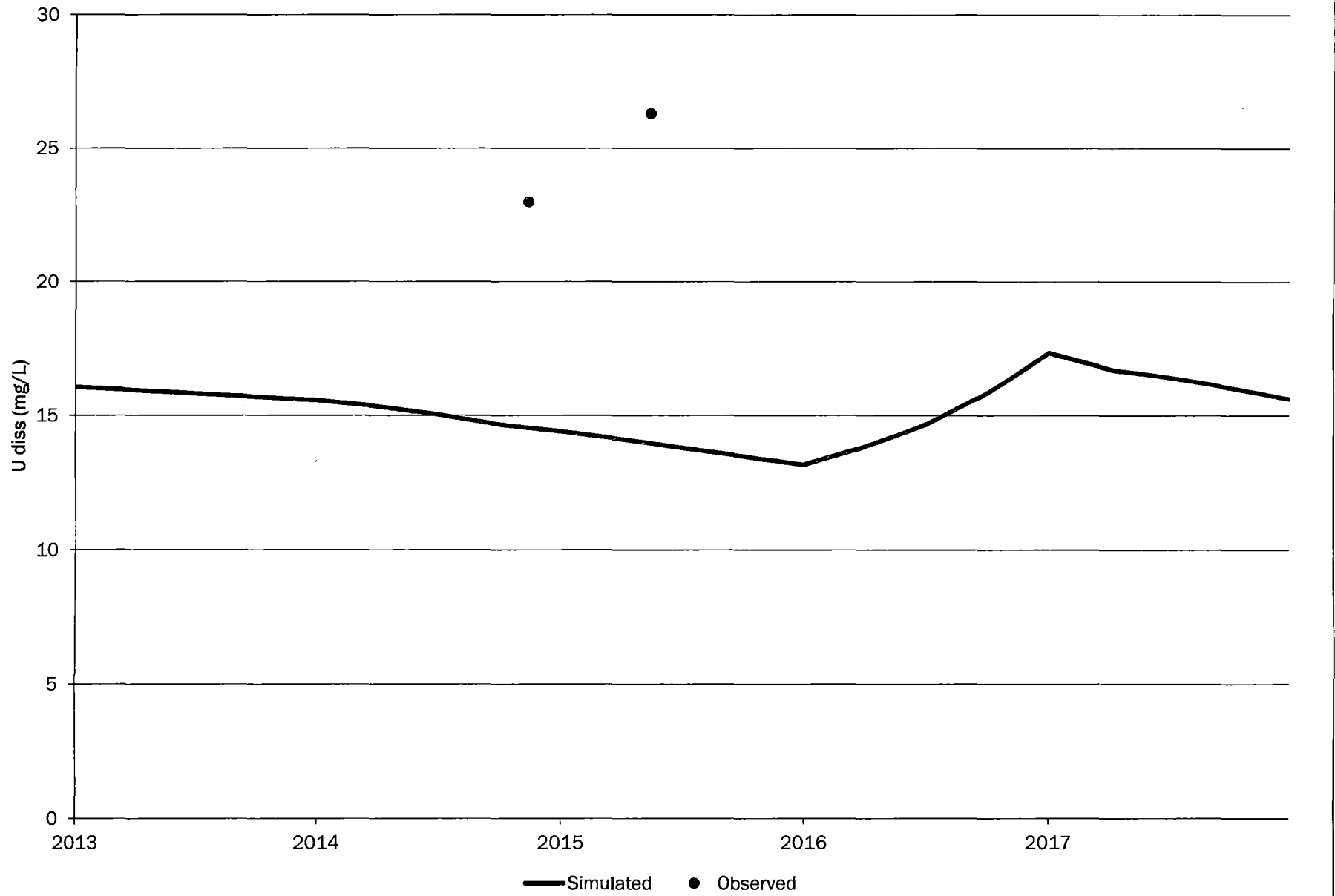
T15-AI



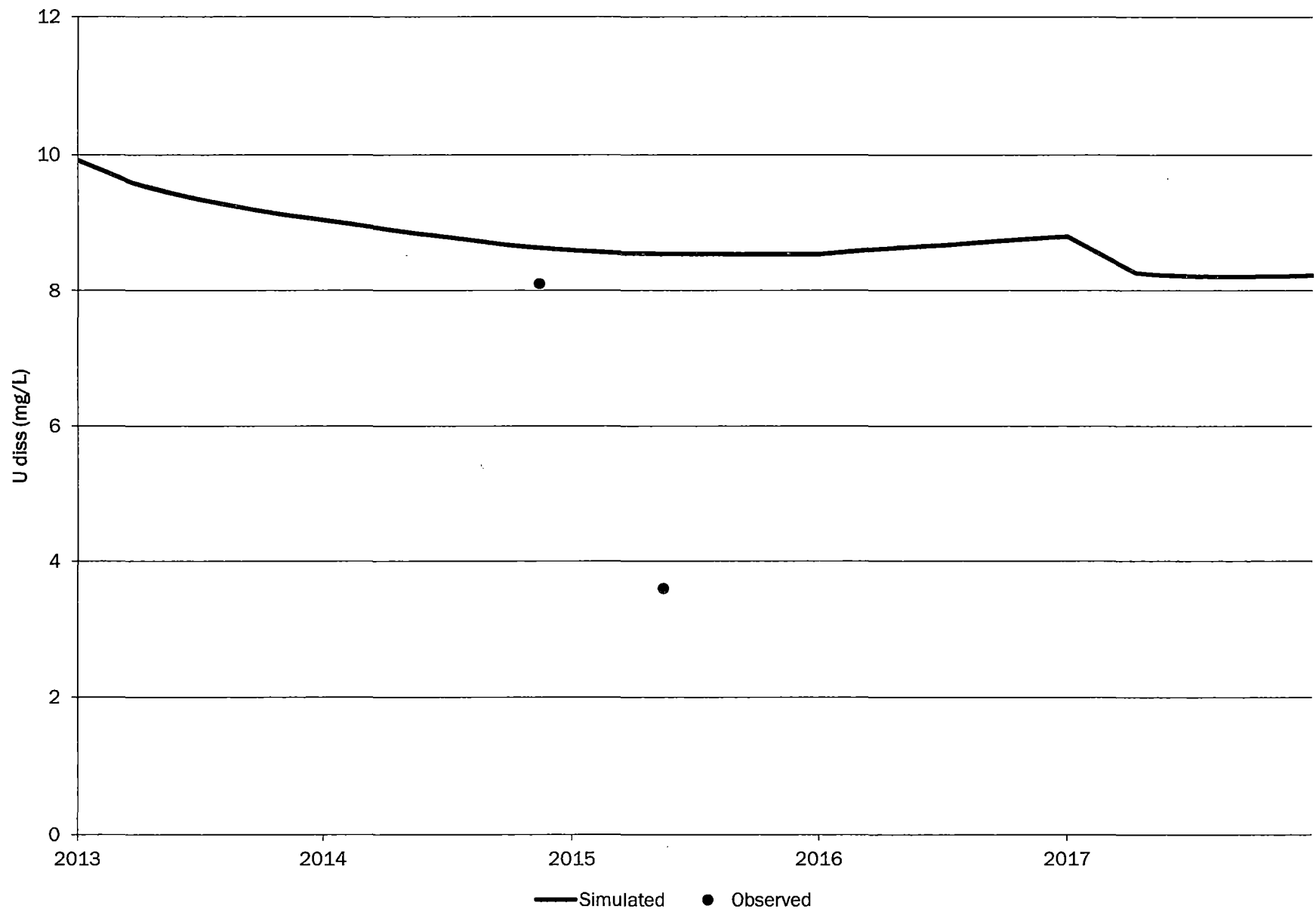
T16-AI



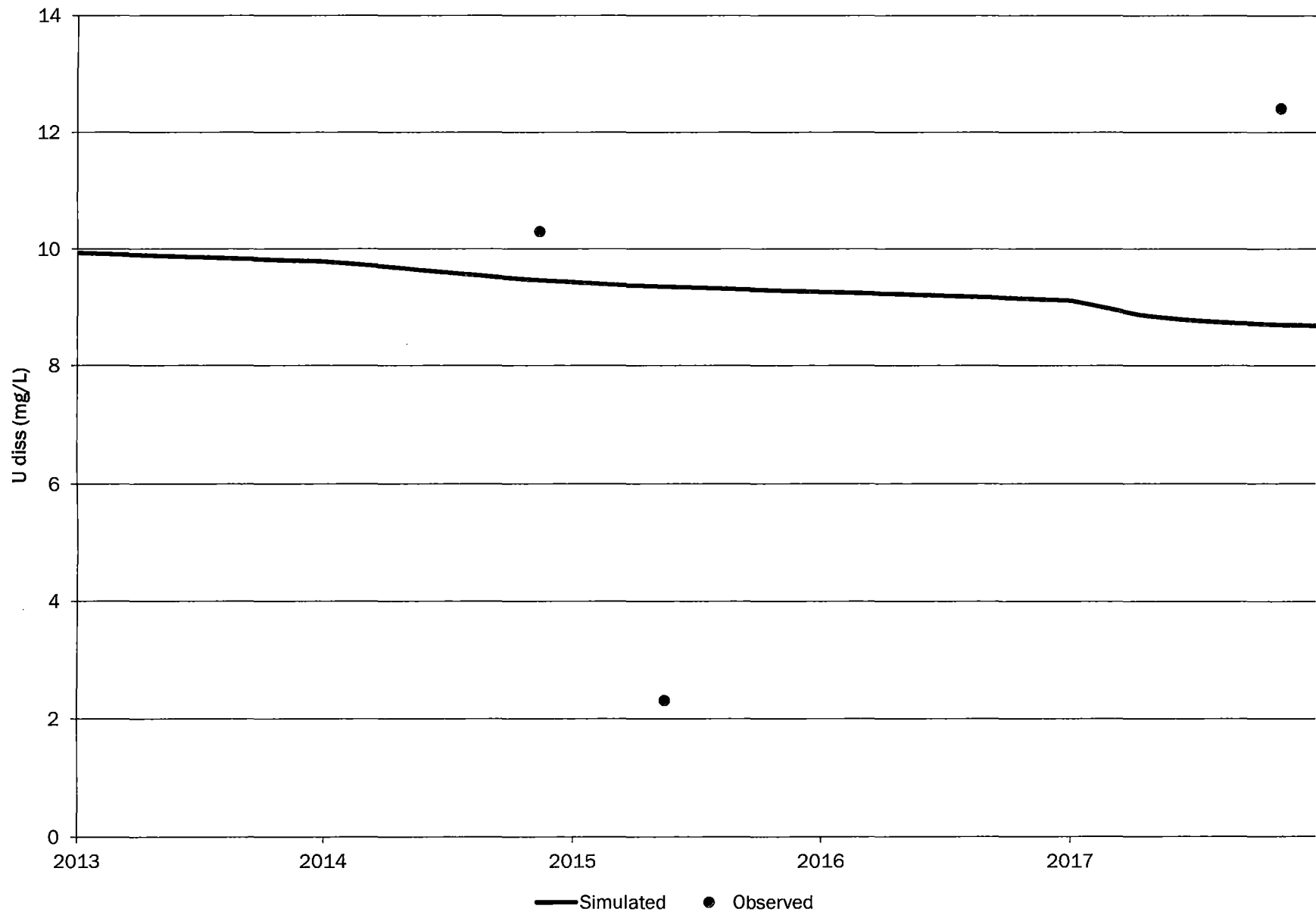
T17-AI



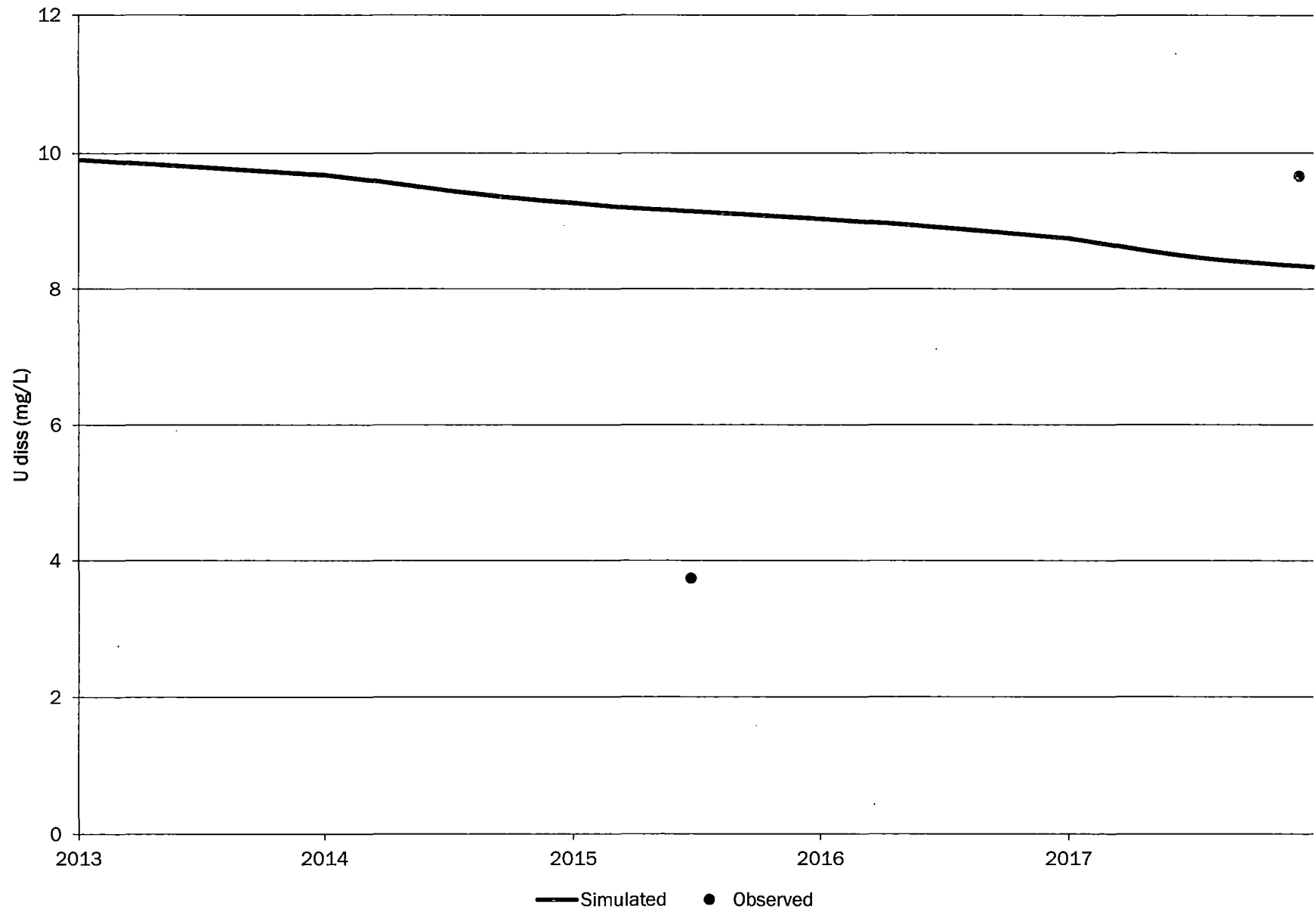
T18-AI



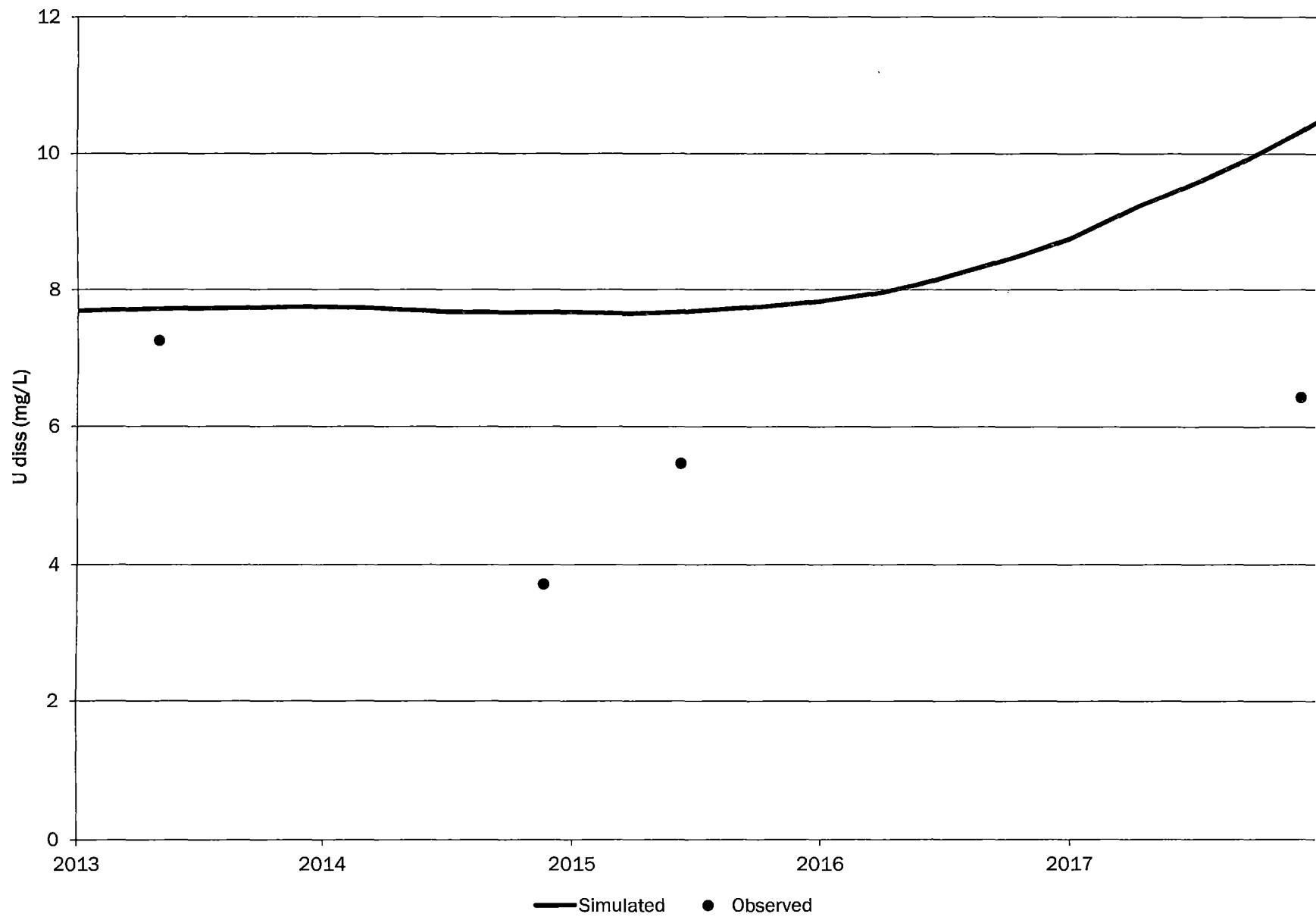
T19-AI



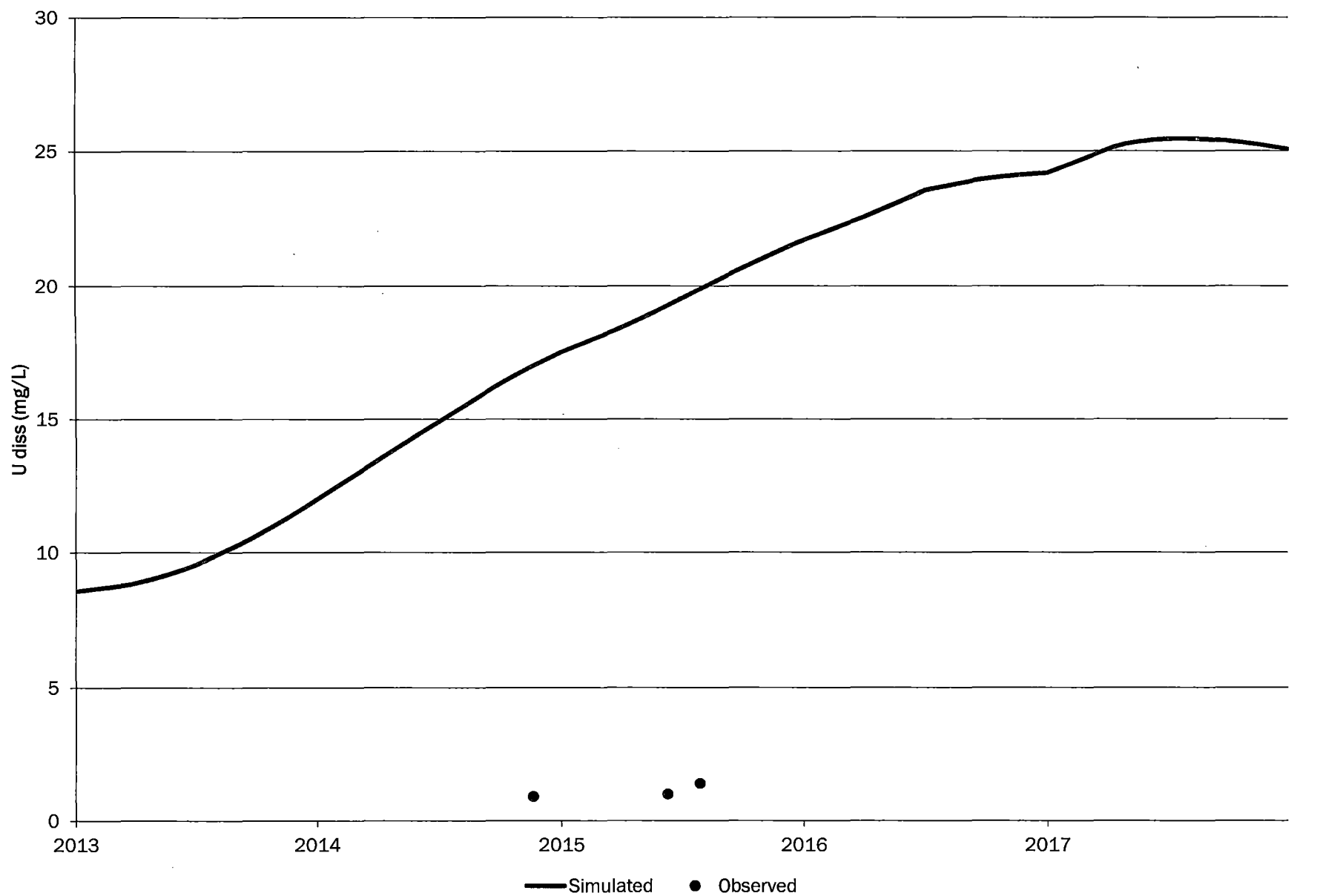
T20-AI



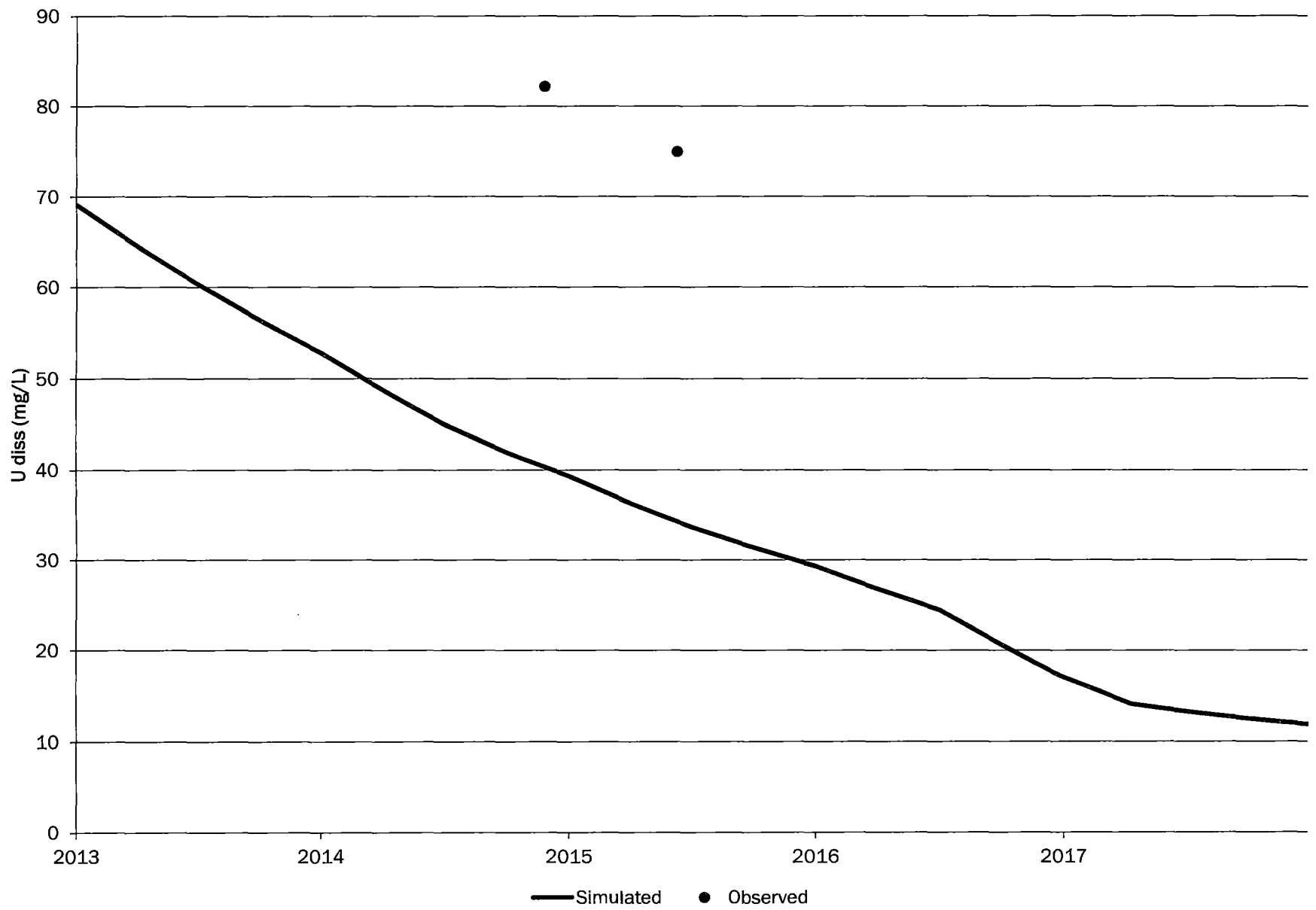
T21-AI



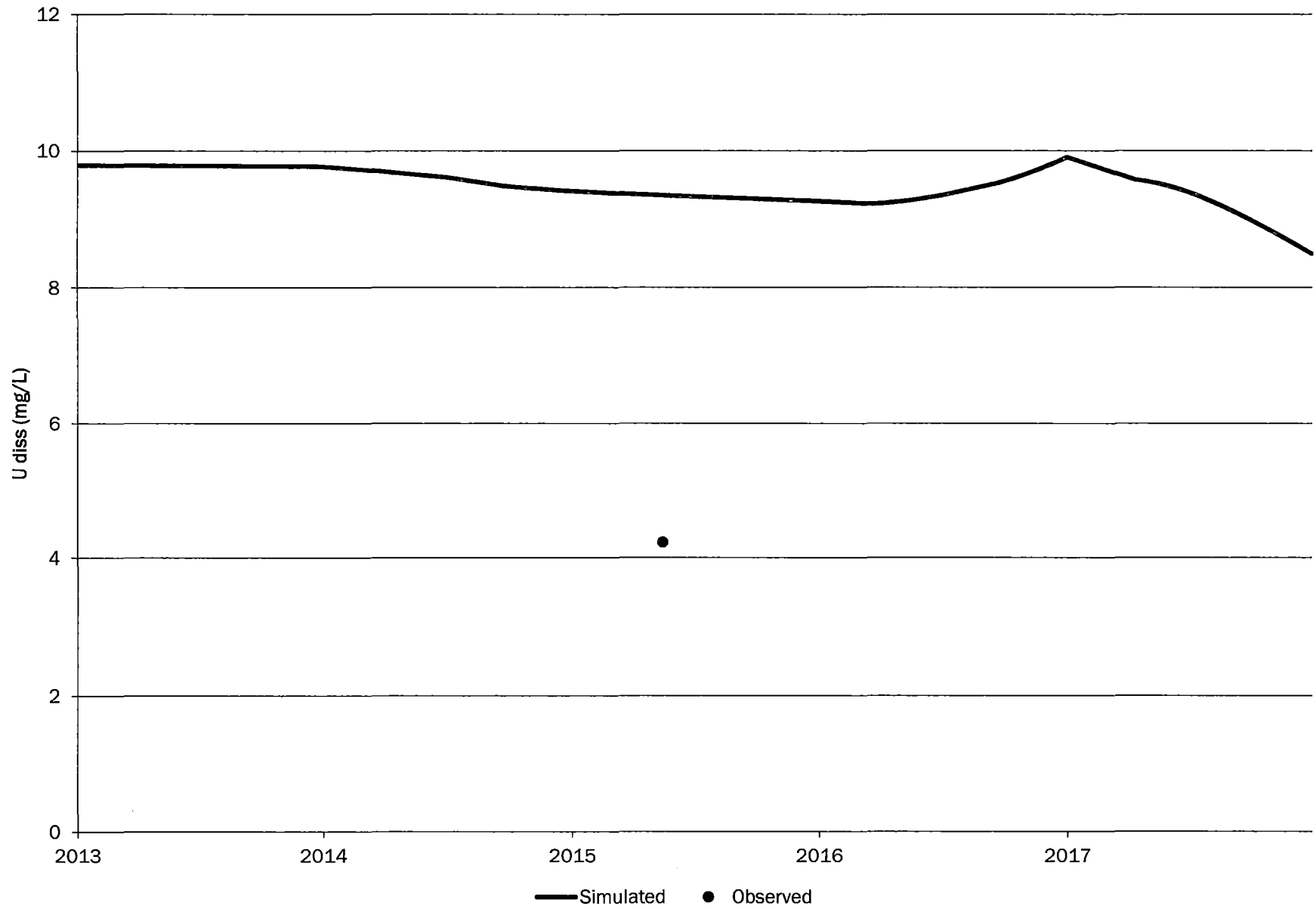
T22-AI



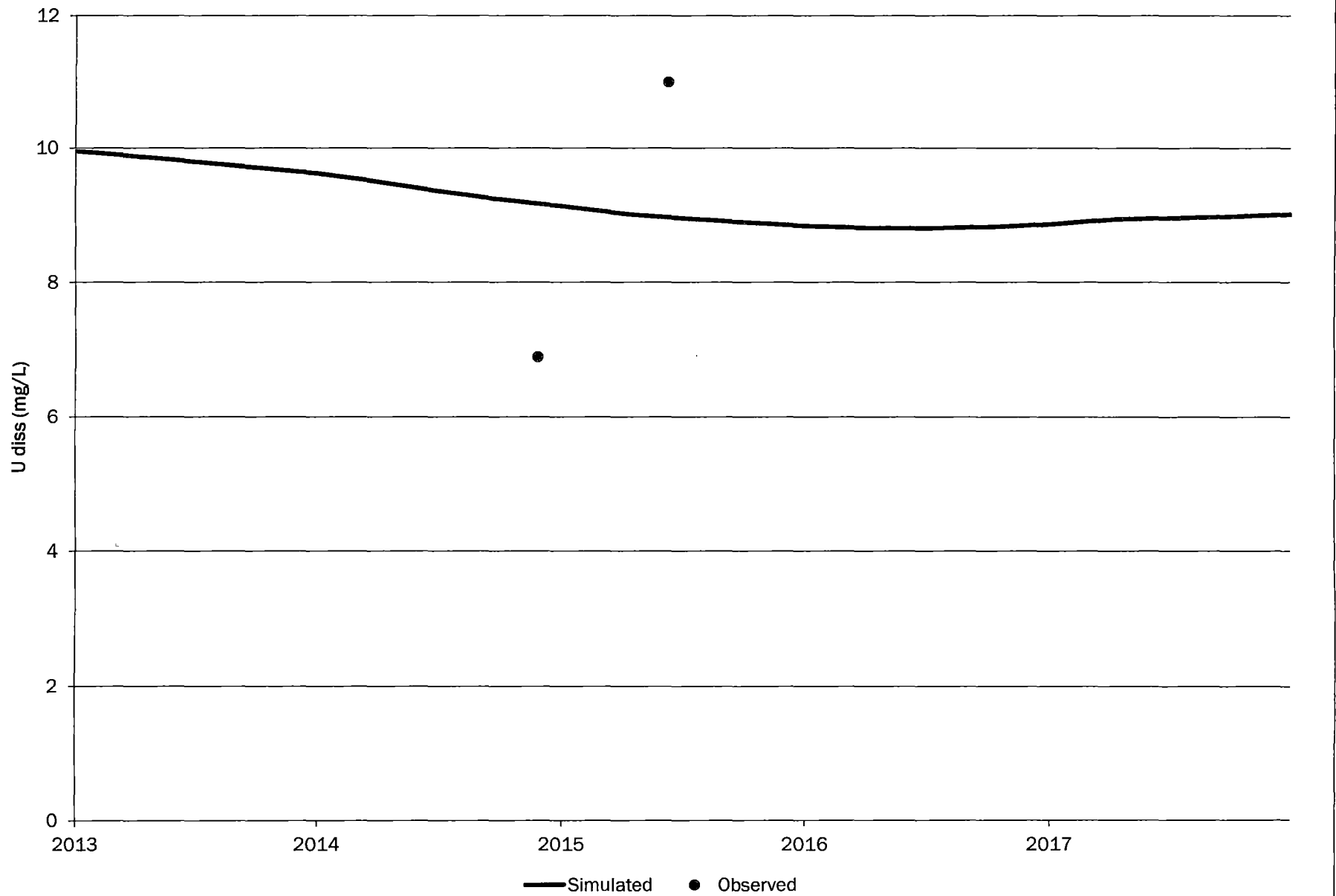
T23-AI



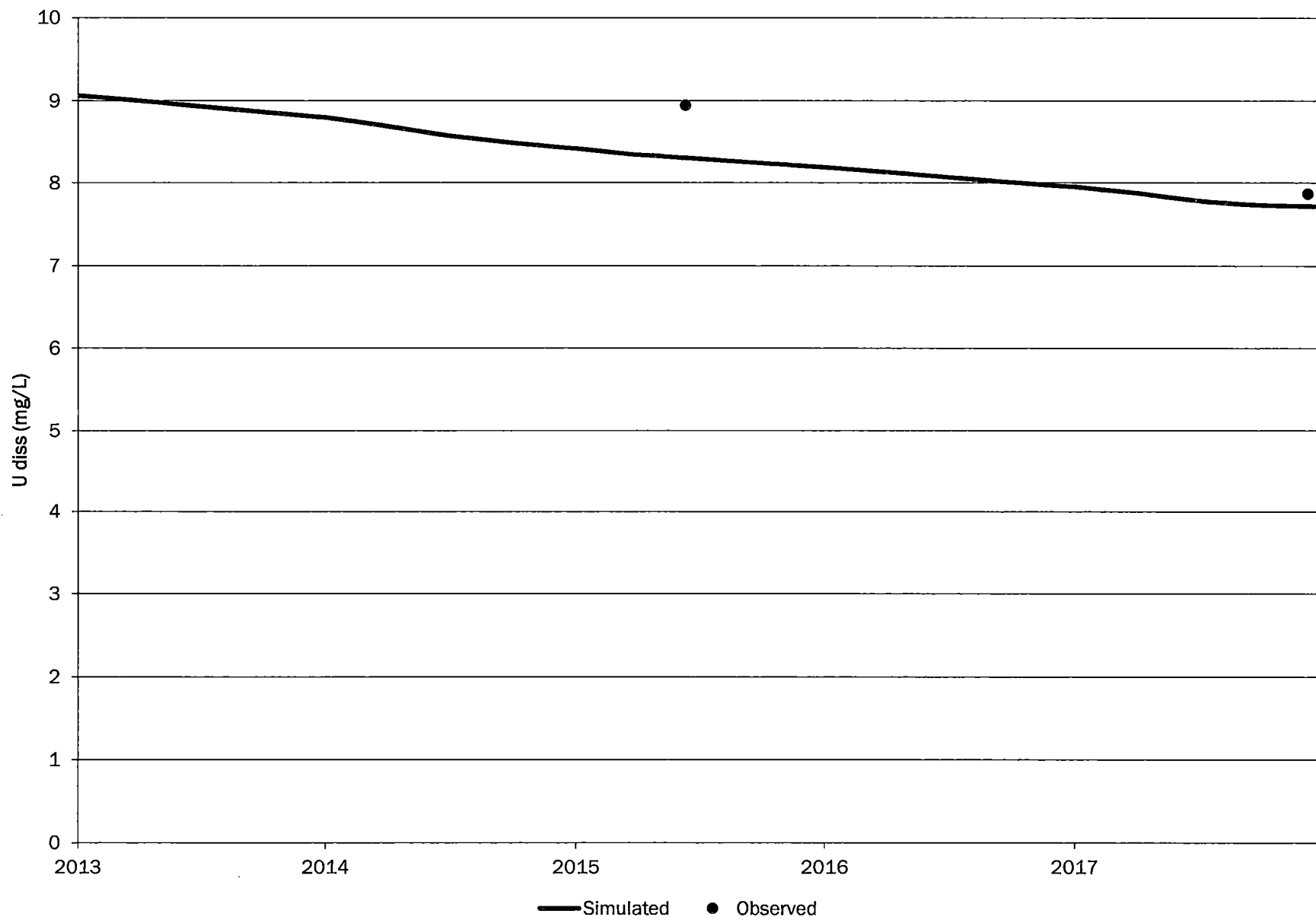
T36-AI



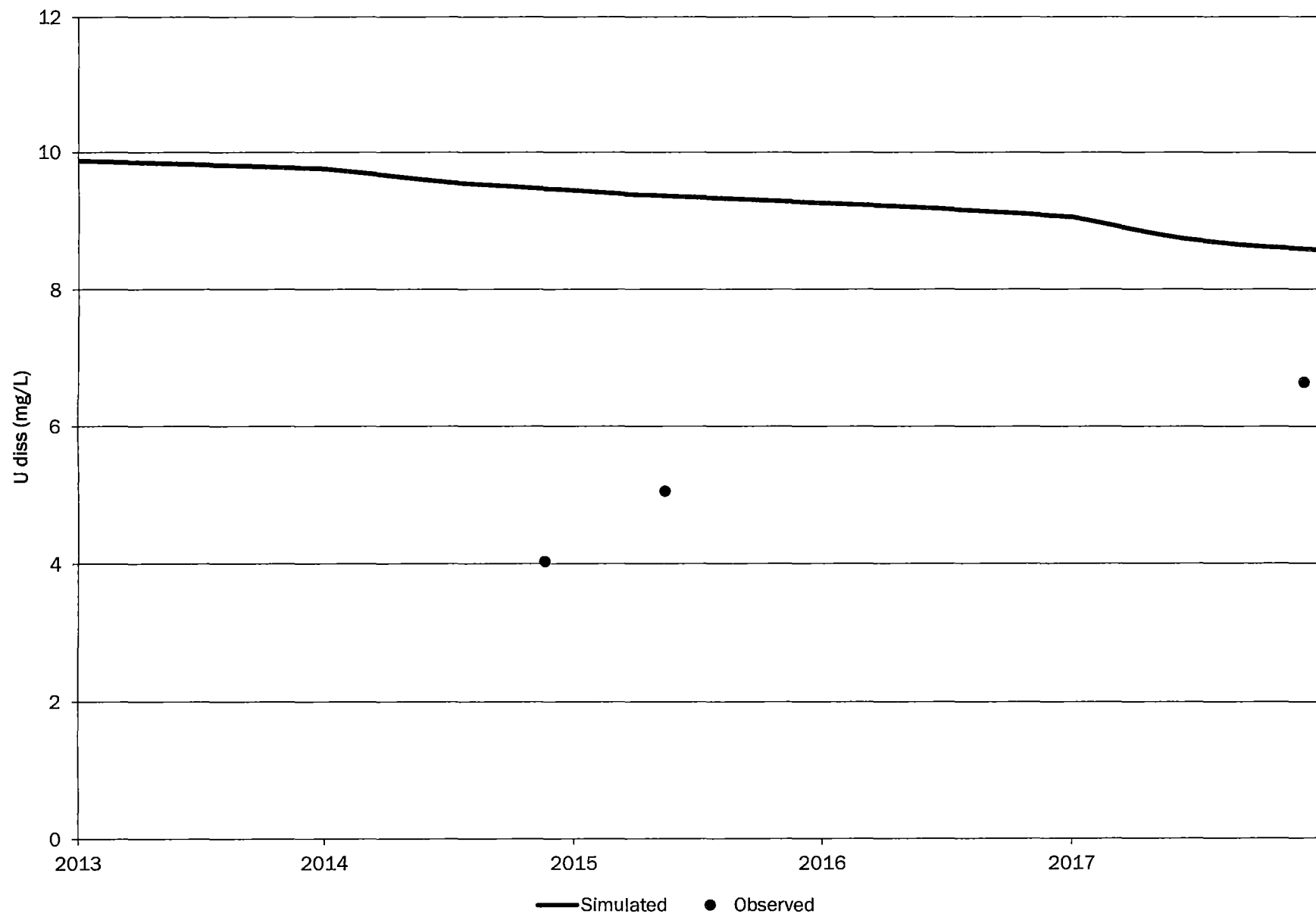
T39-AI



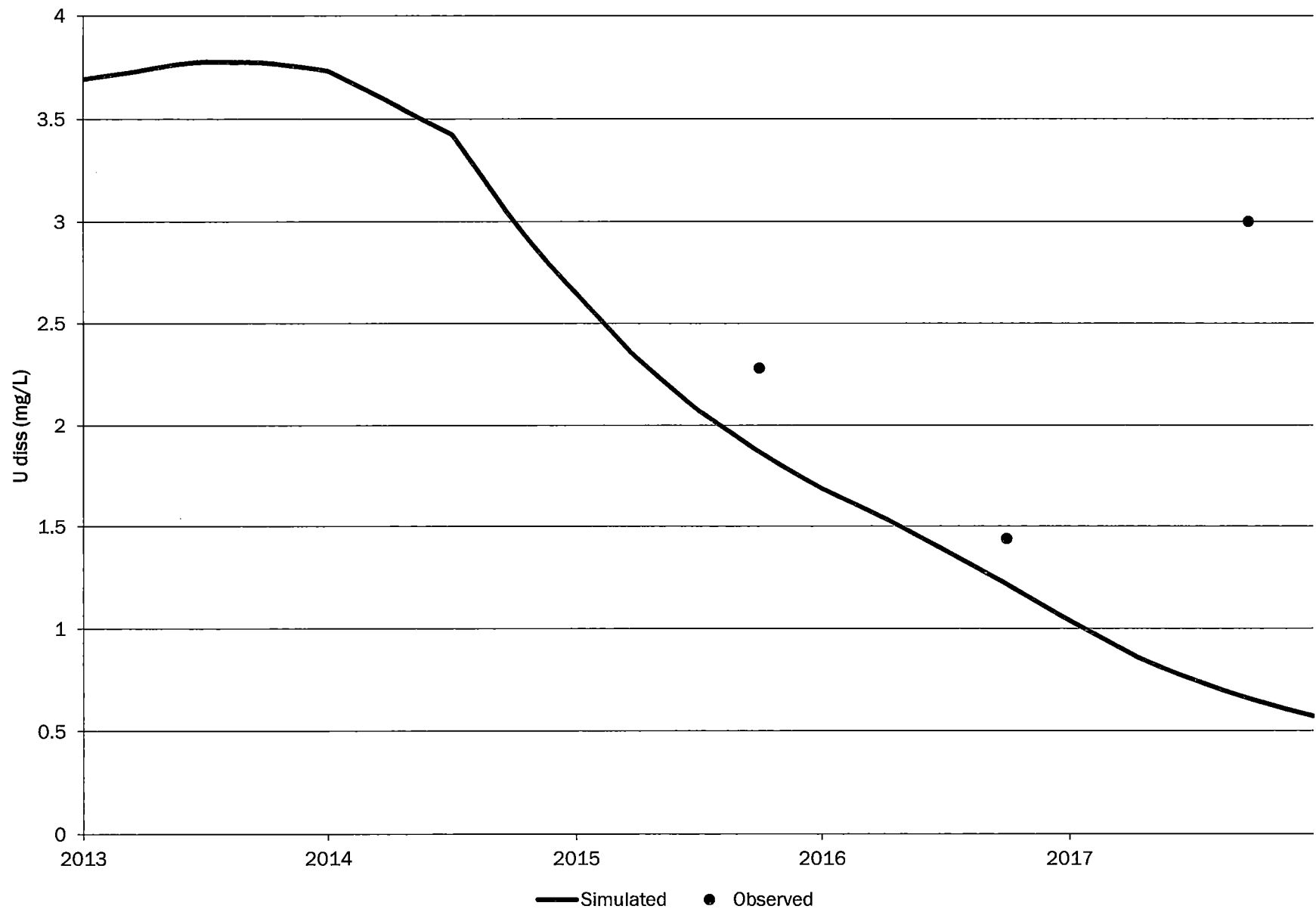
T40-AI



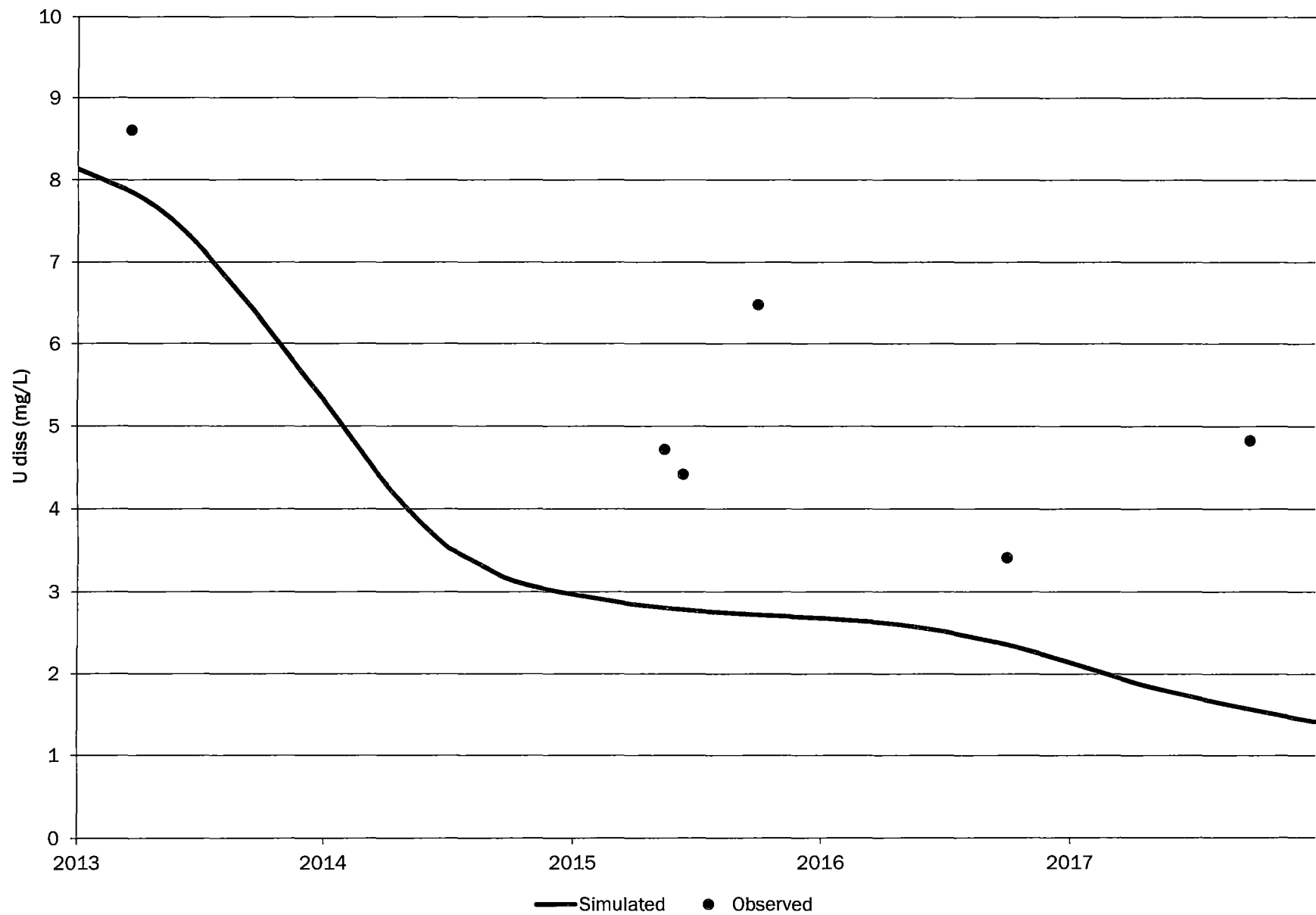
T41-AI



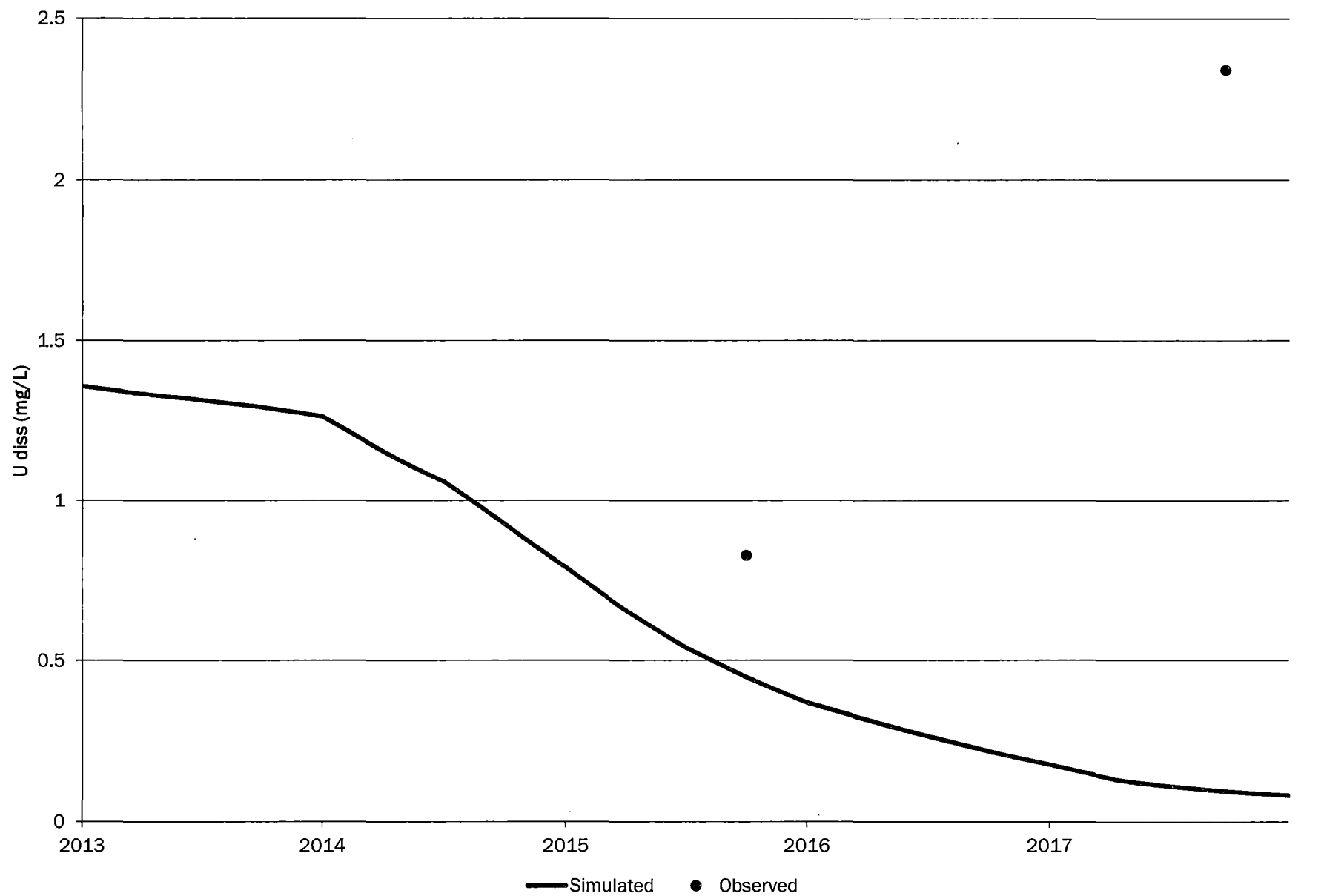
TA-AI



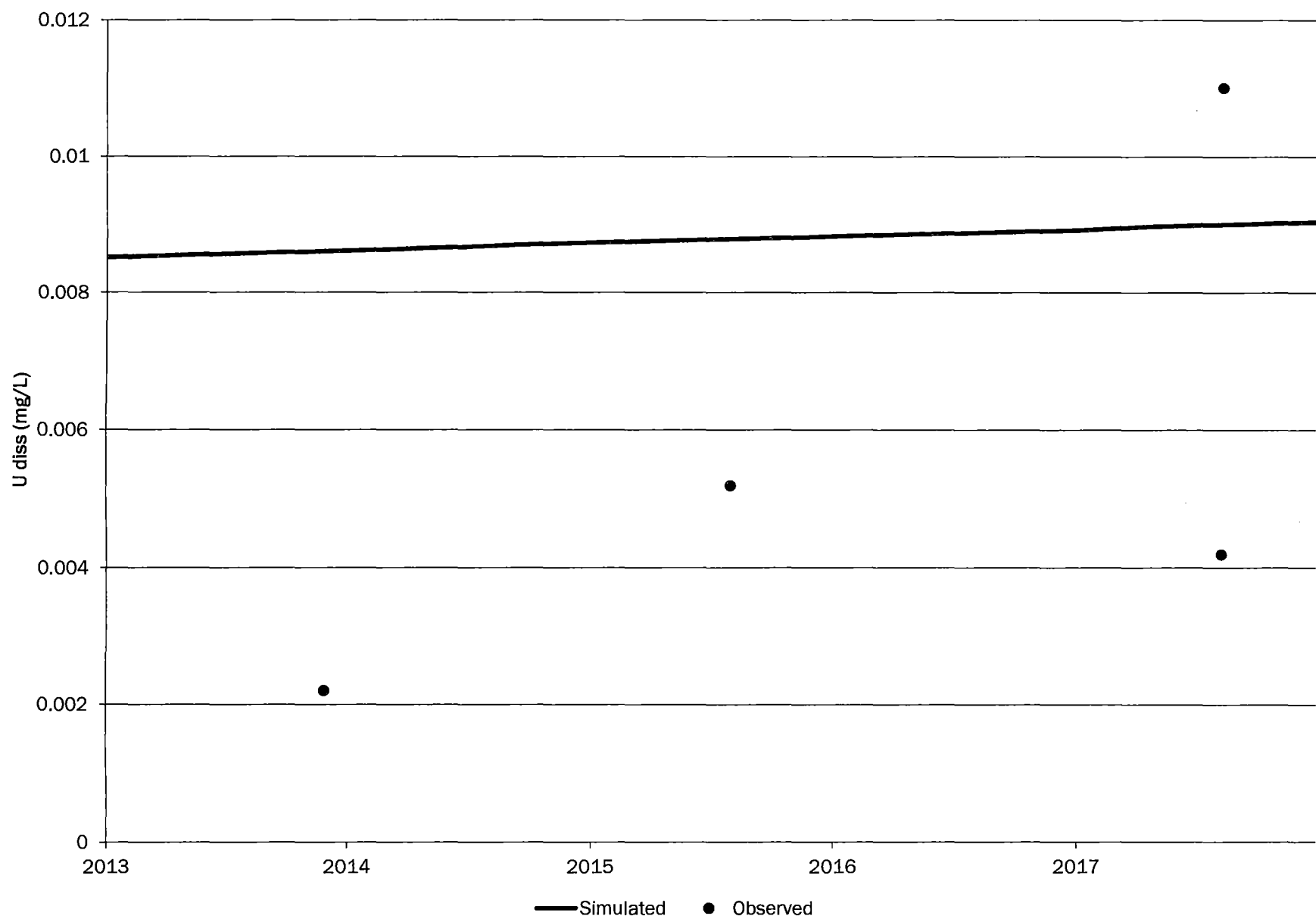
T-AI



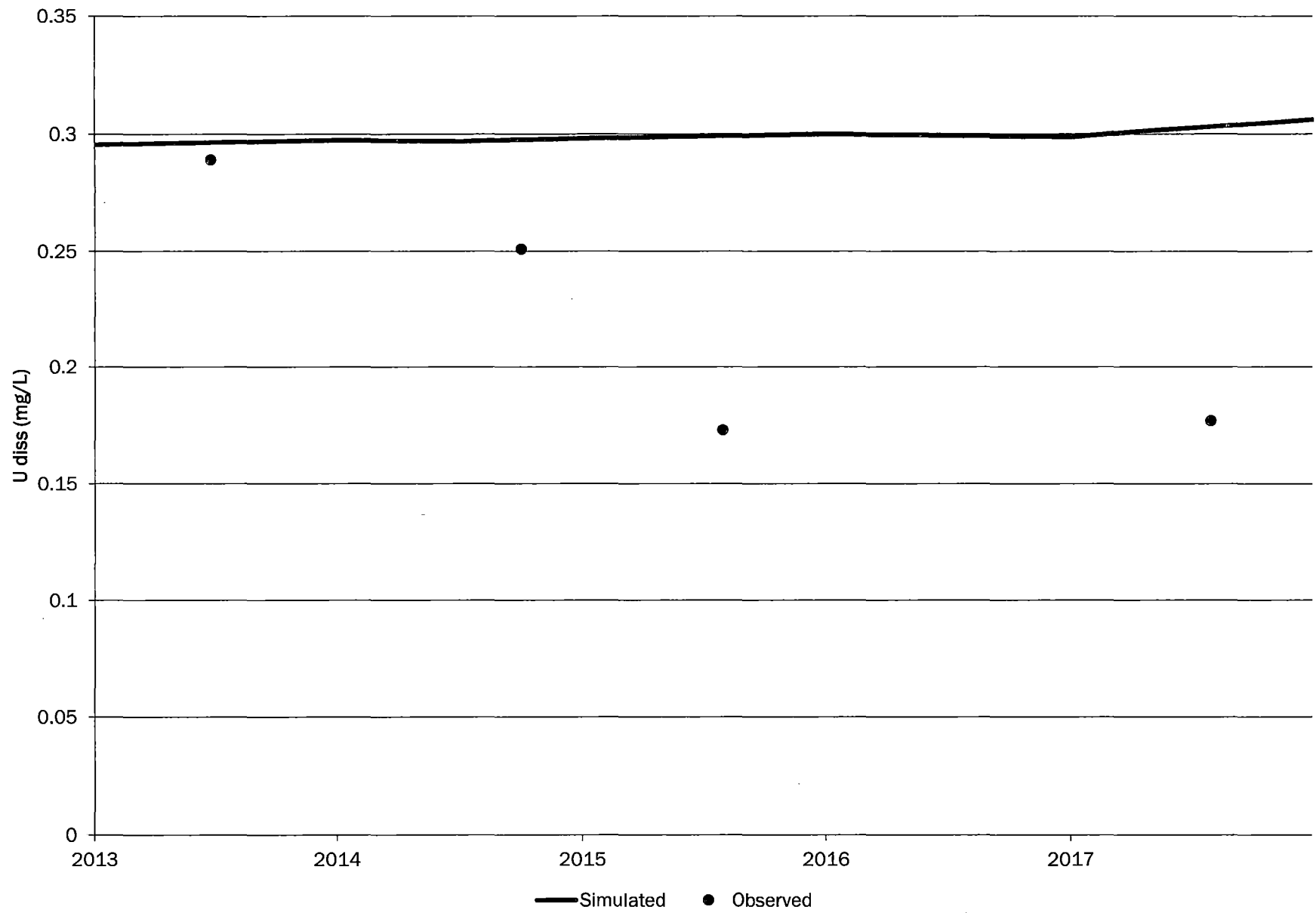
TB-AI



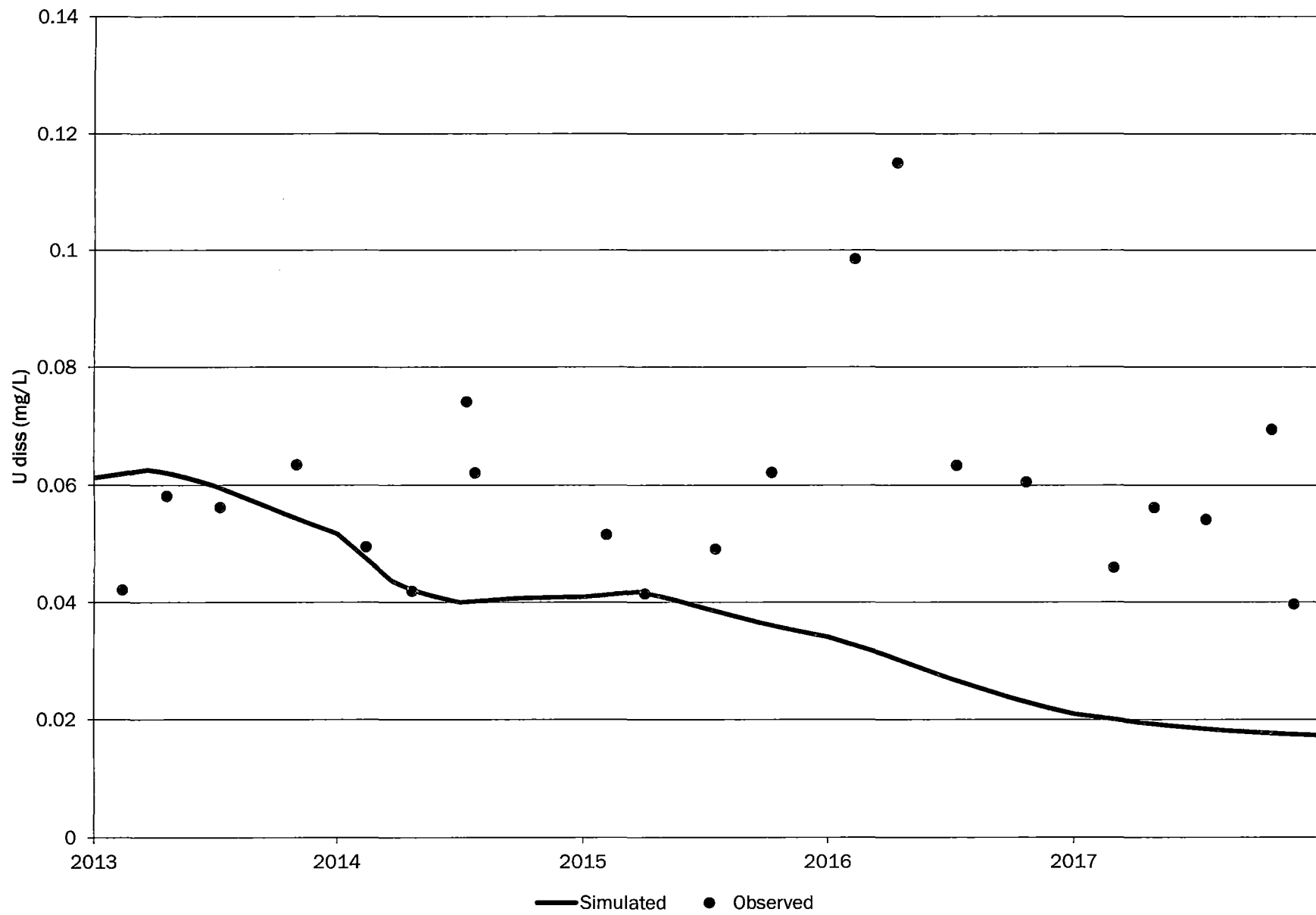
WCW-MC



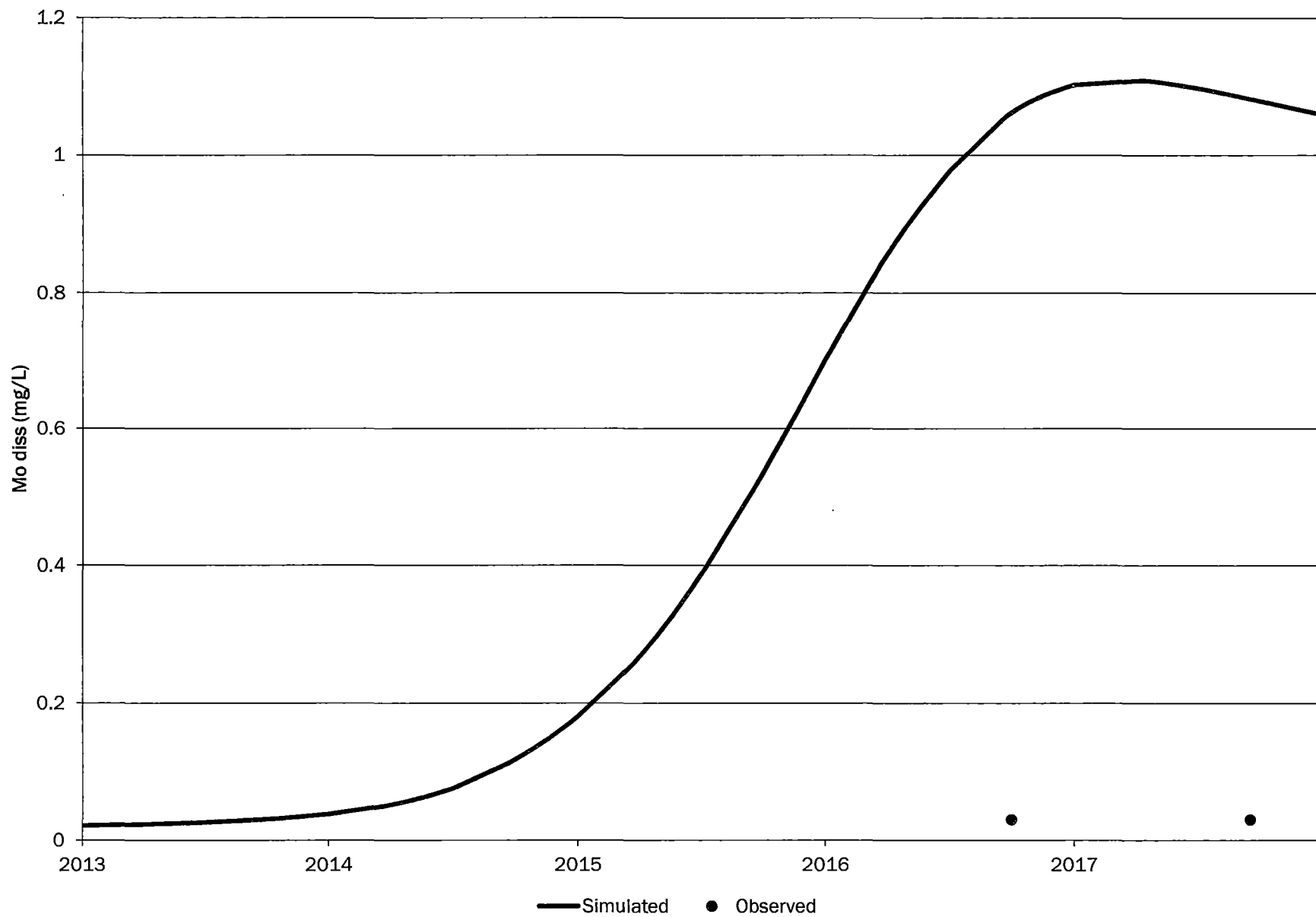
WR25-MC



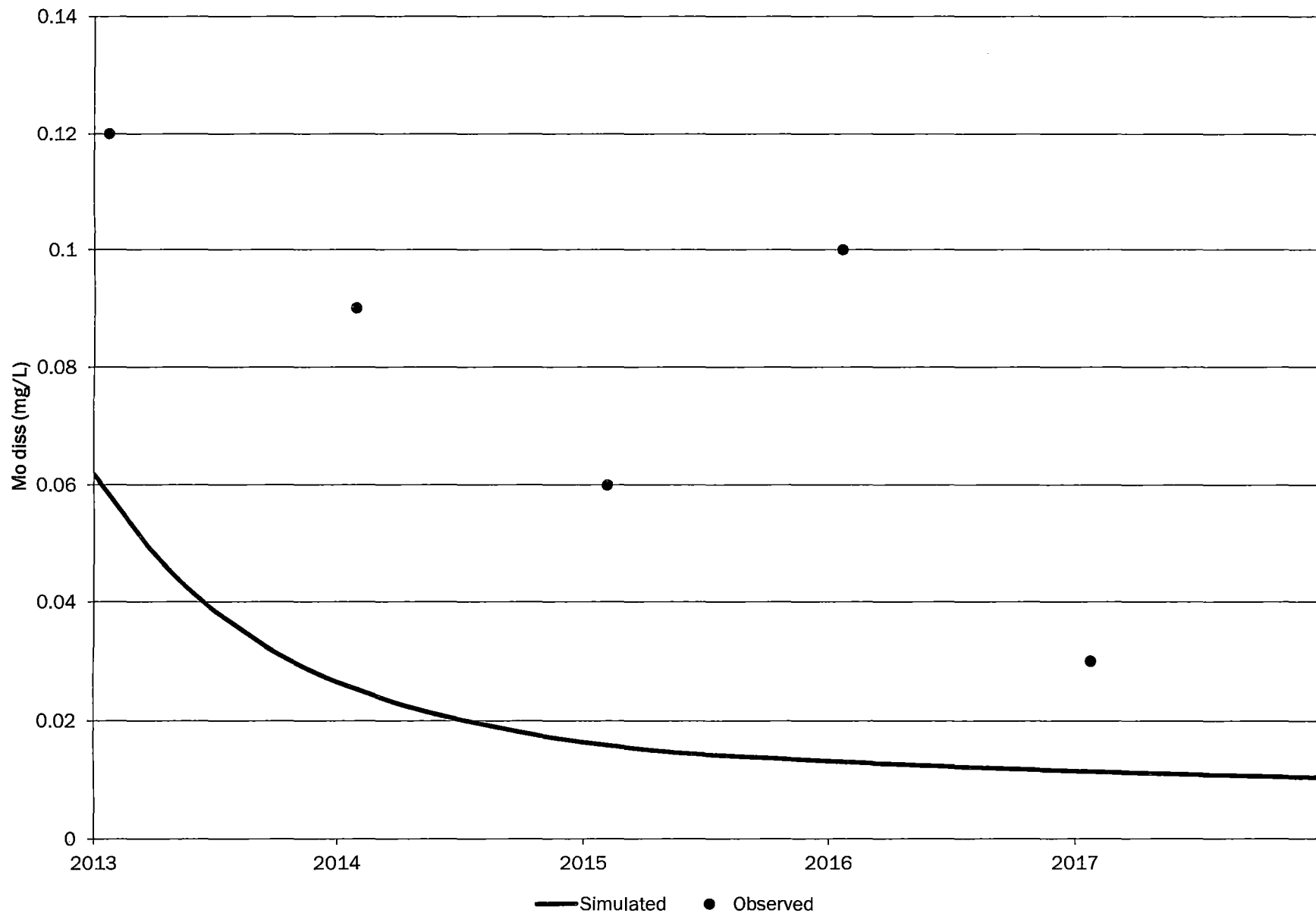
X-AI



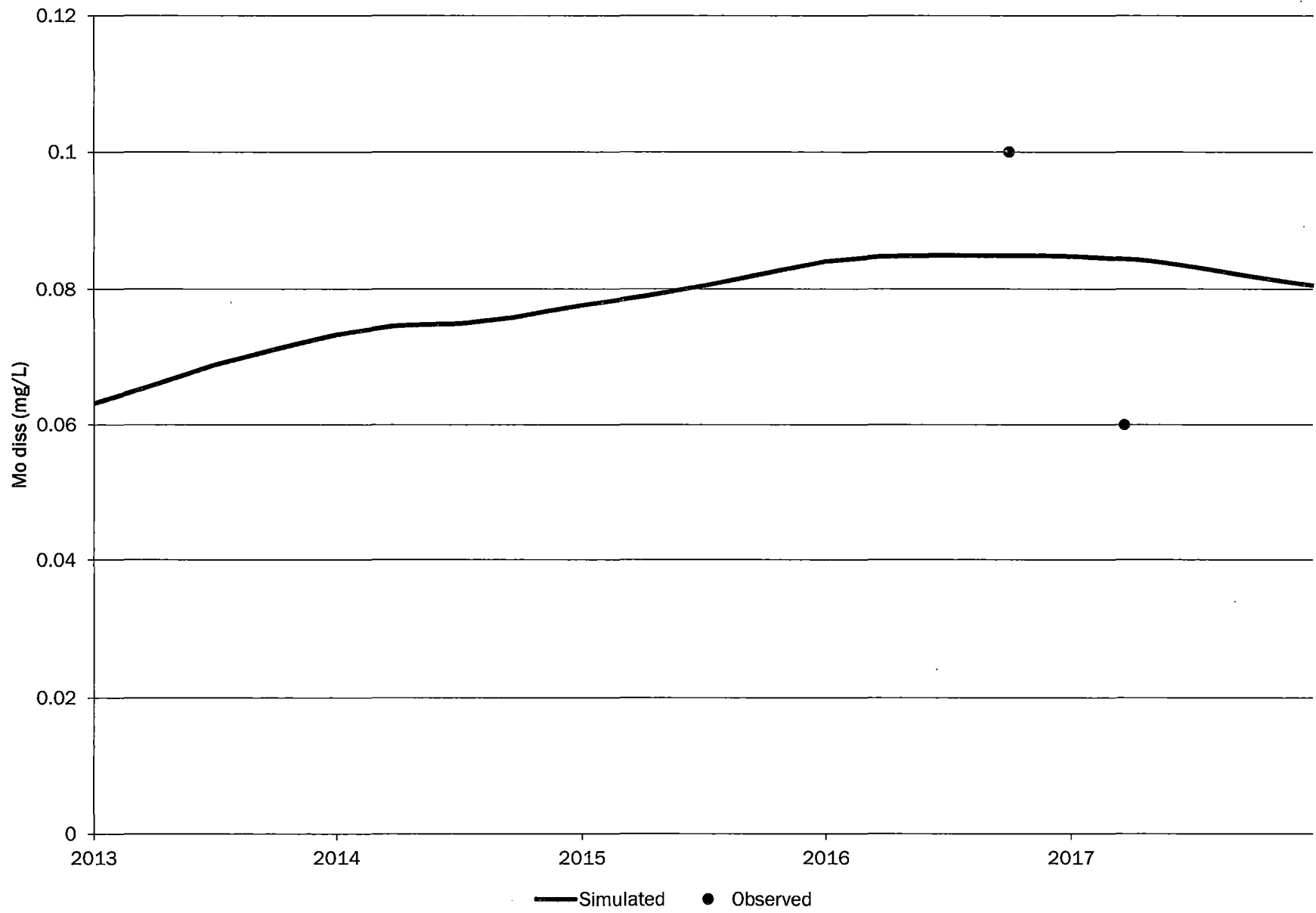
1F-AI



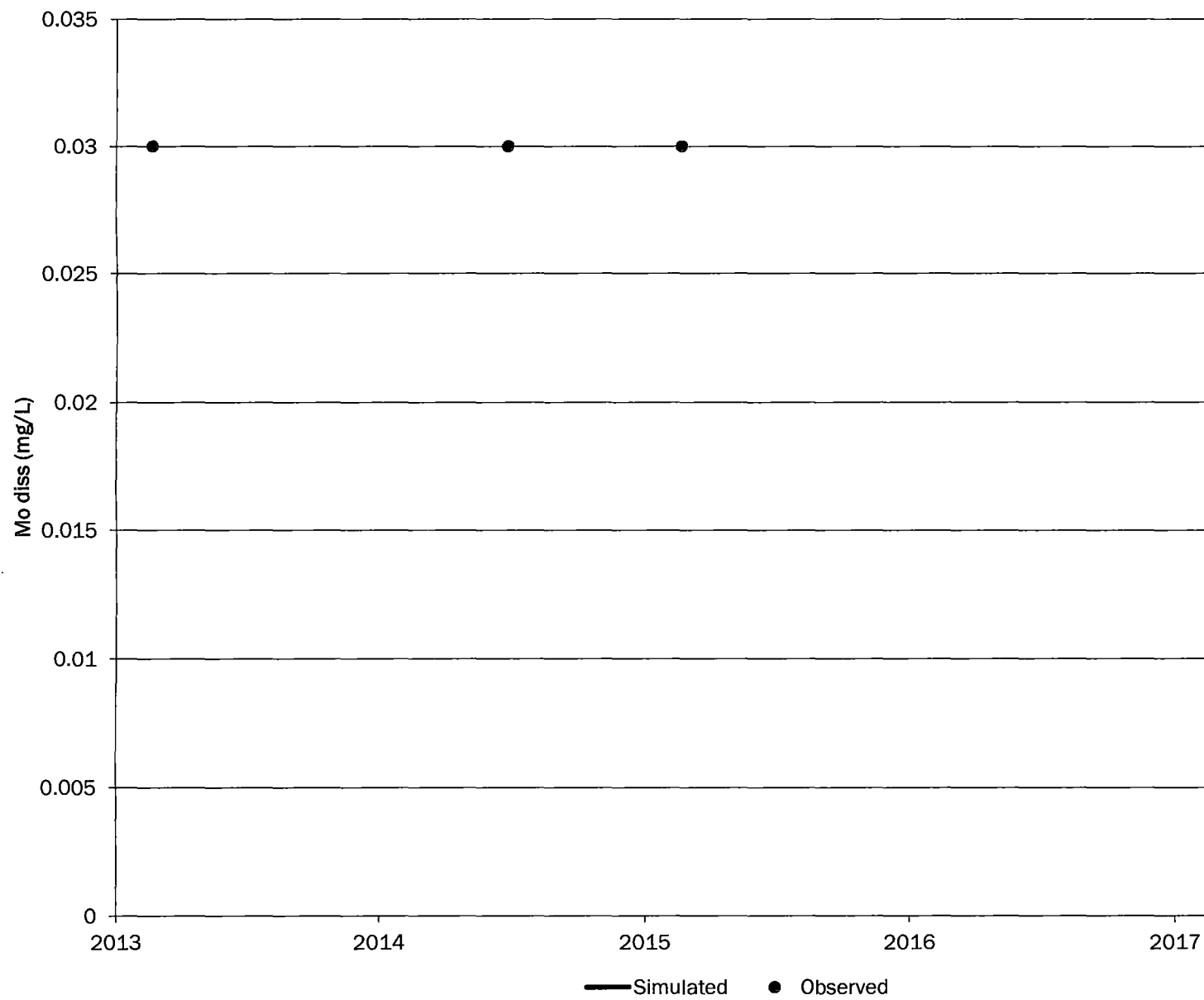
1J-AI



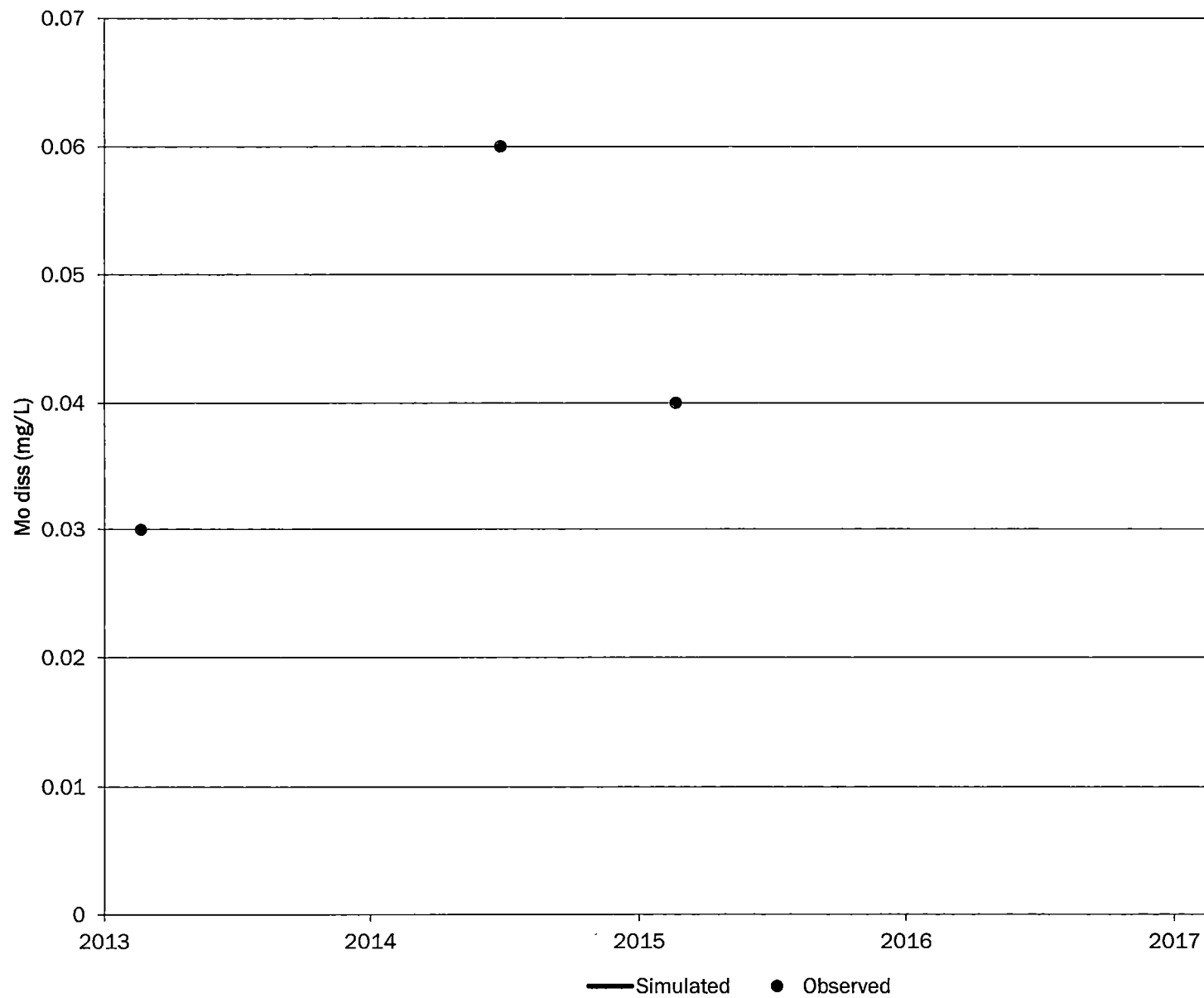
1M-AI



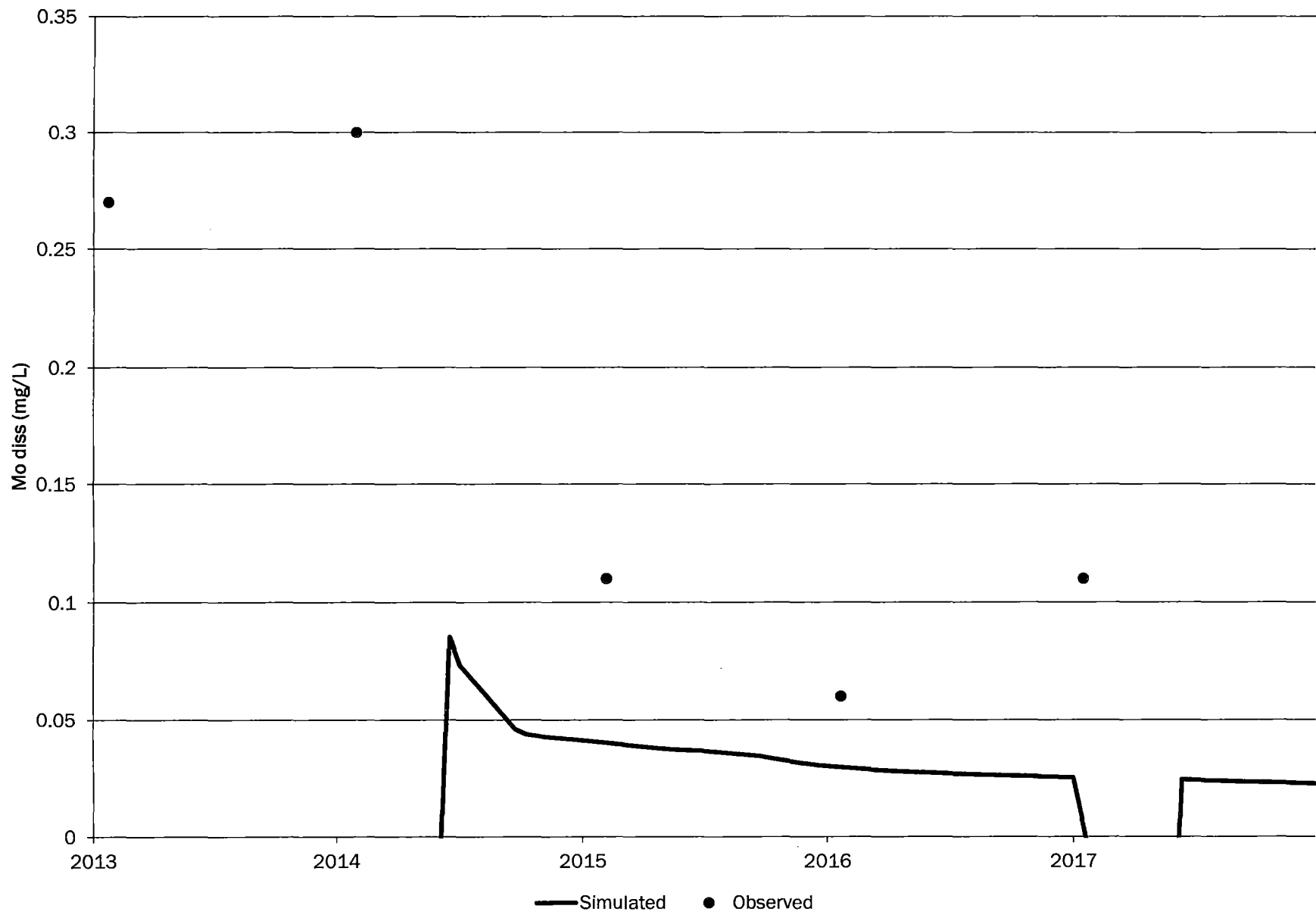
1N-AI



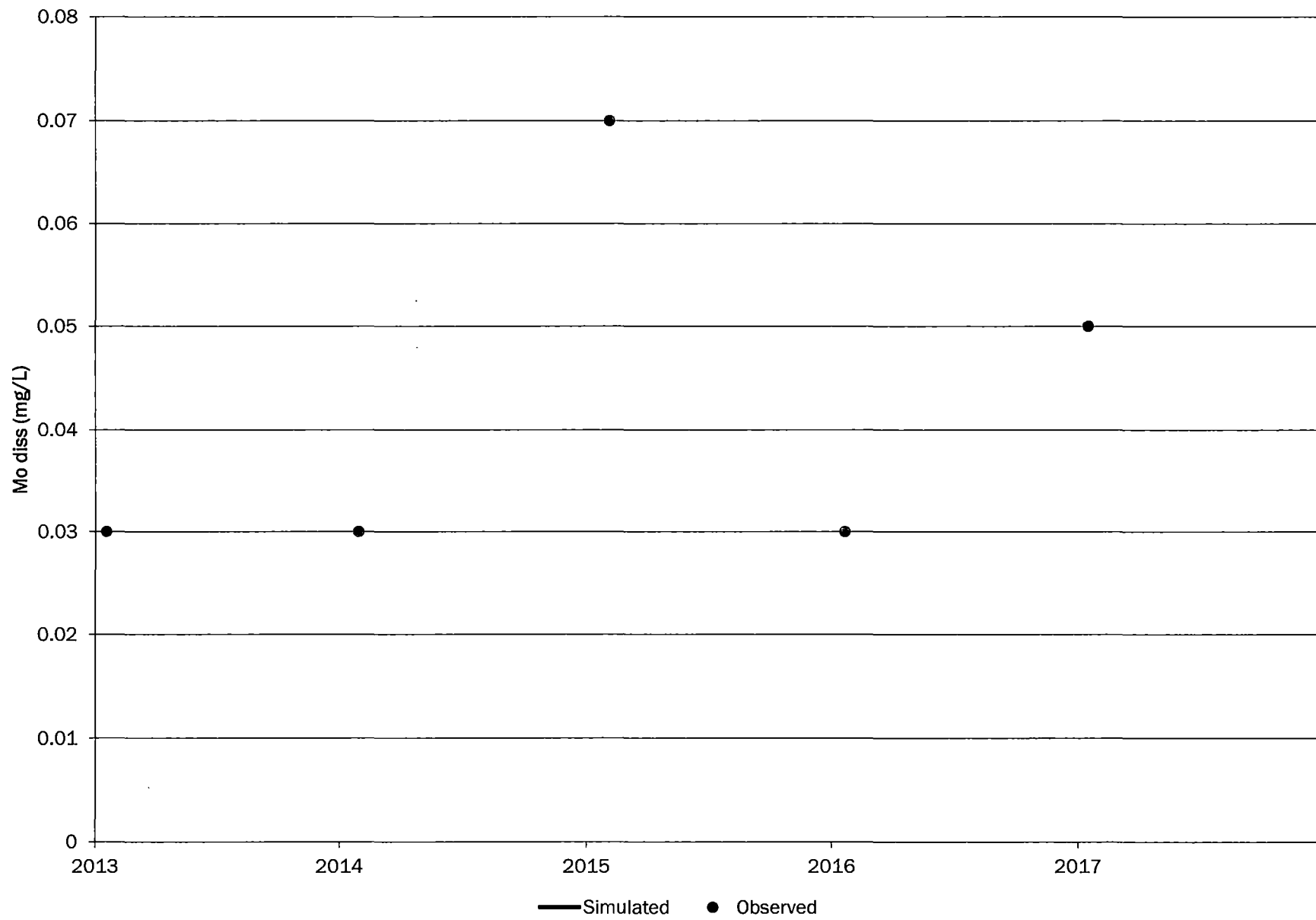
1P-AI



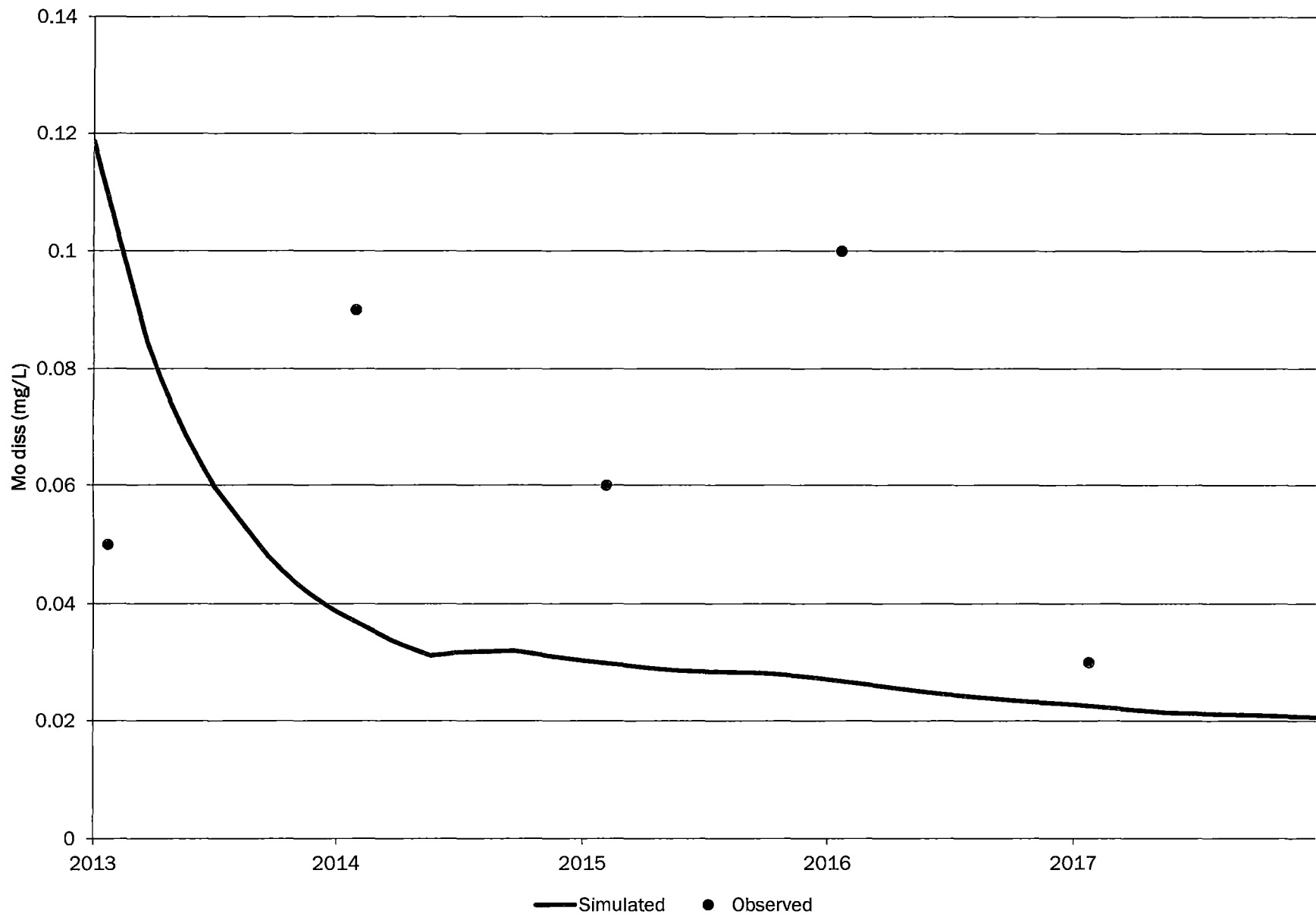
1Q-AI



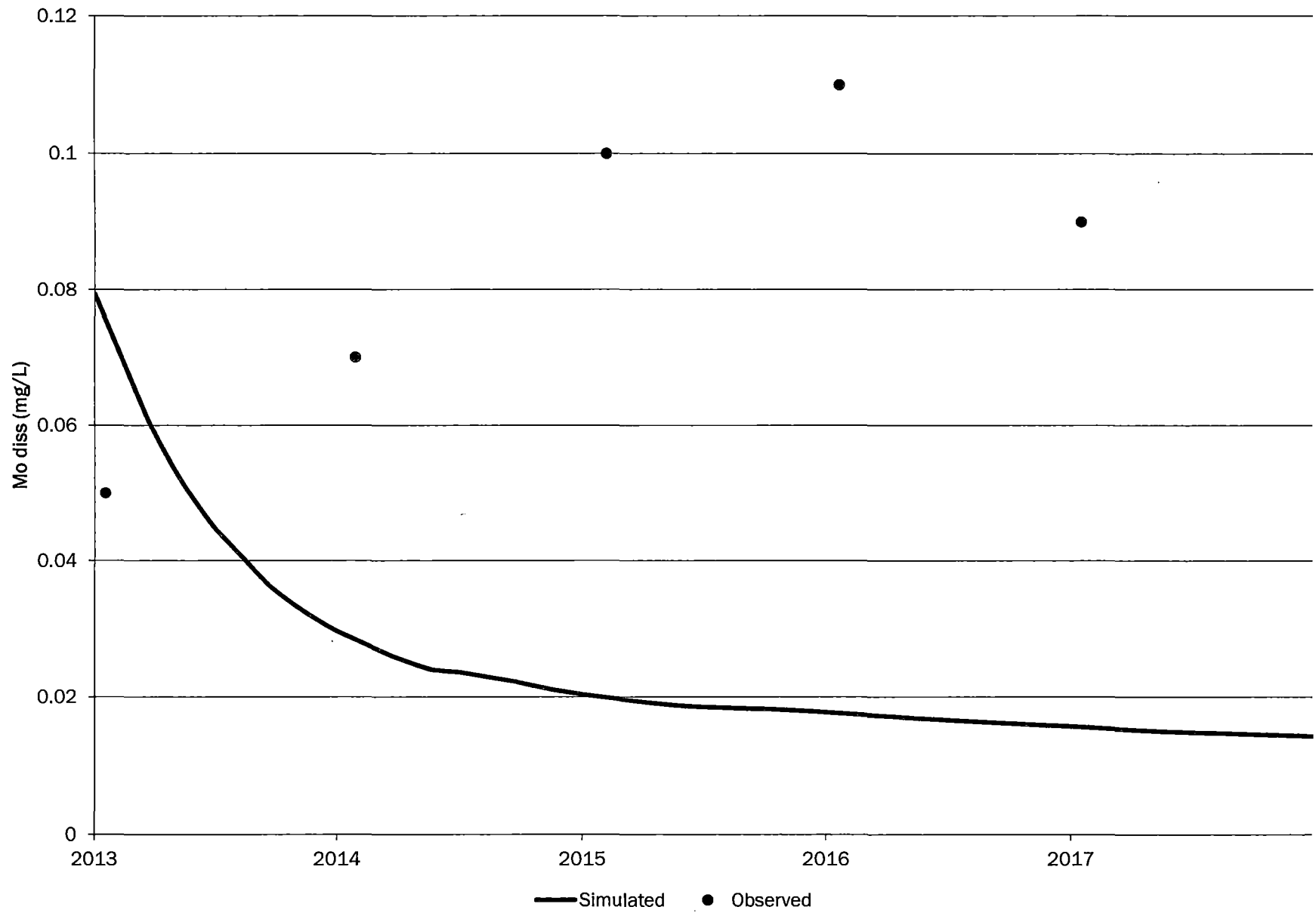
1R-AI



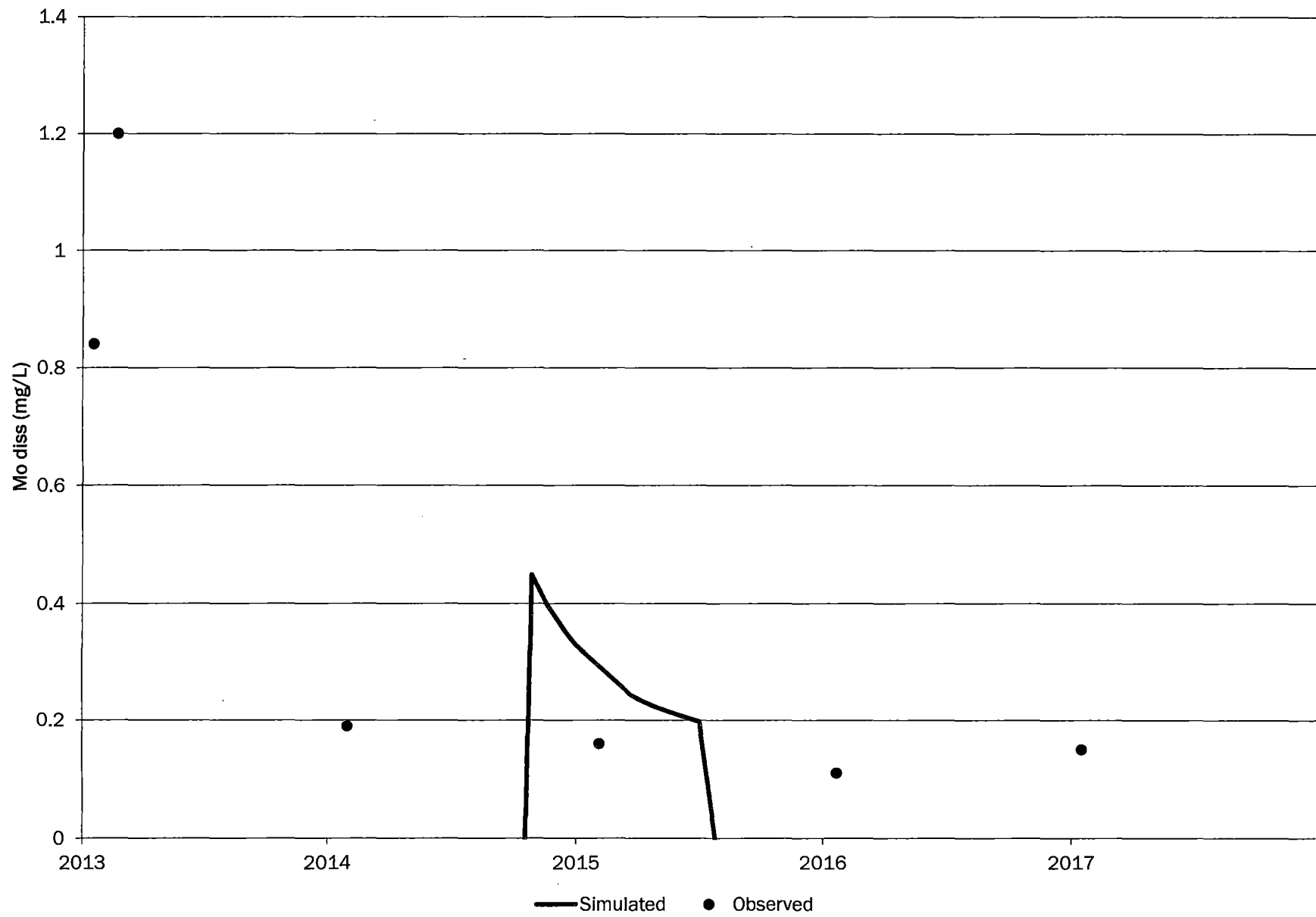
1S-AI



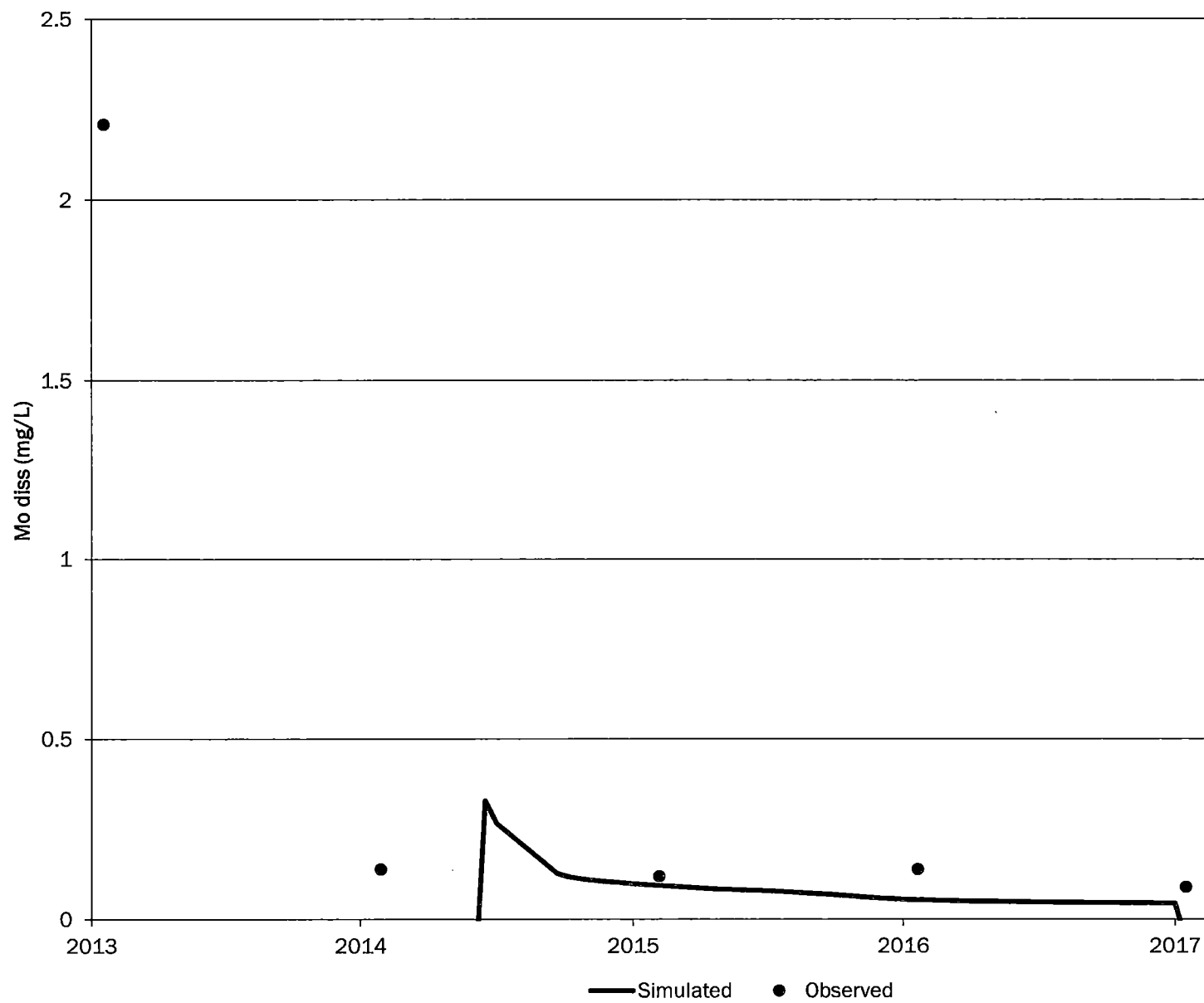
1T-AI



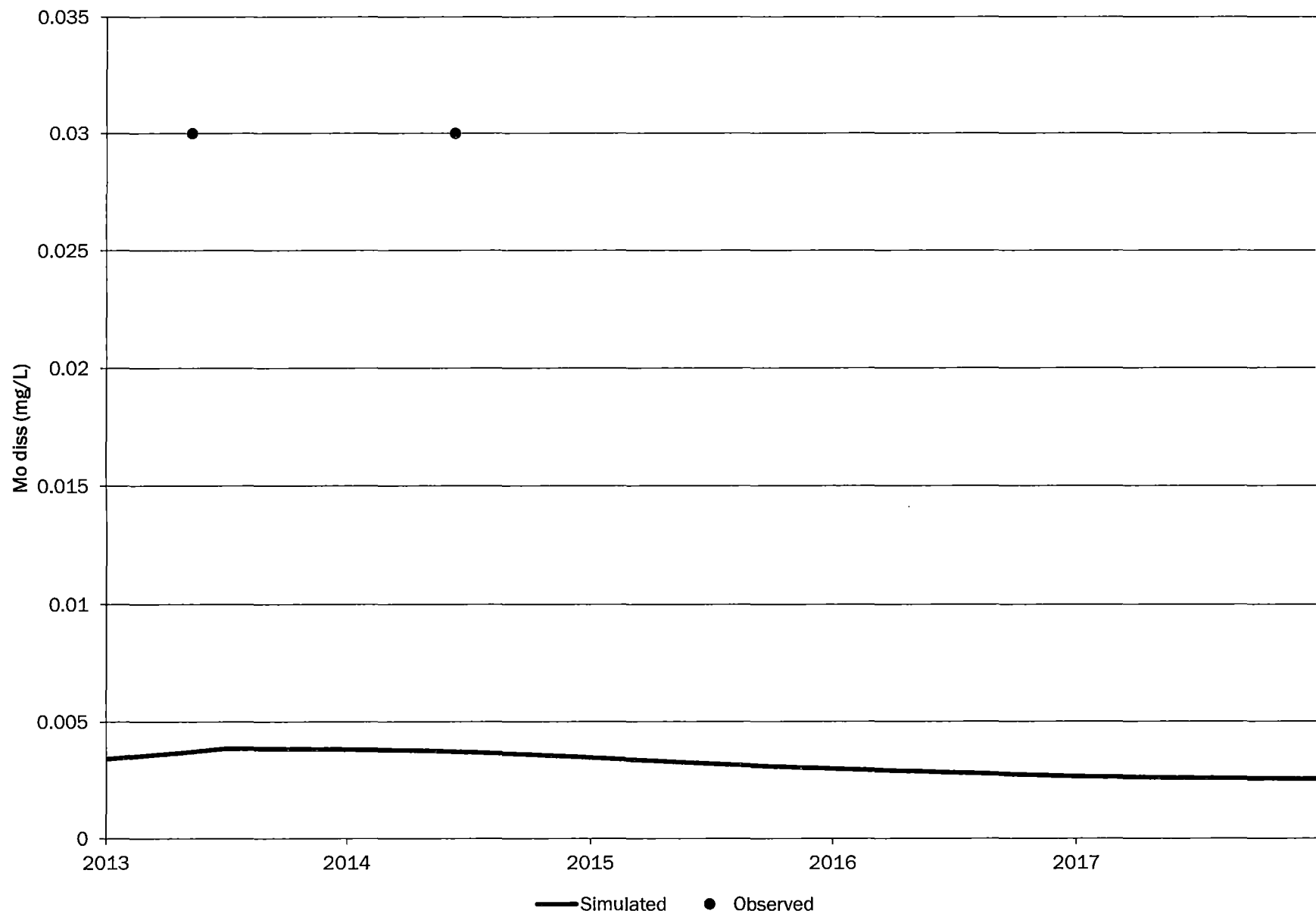
1U-AI



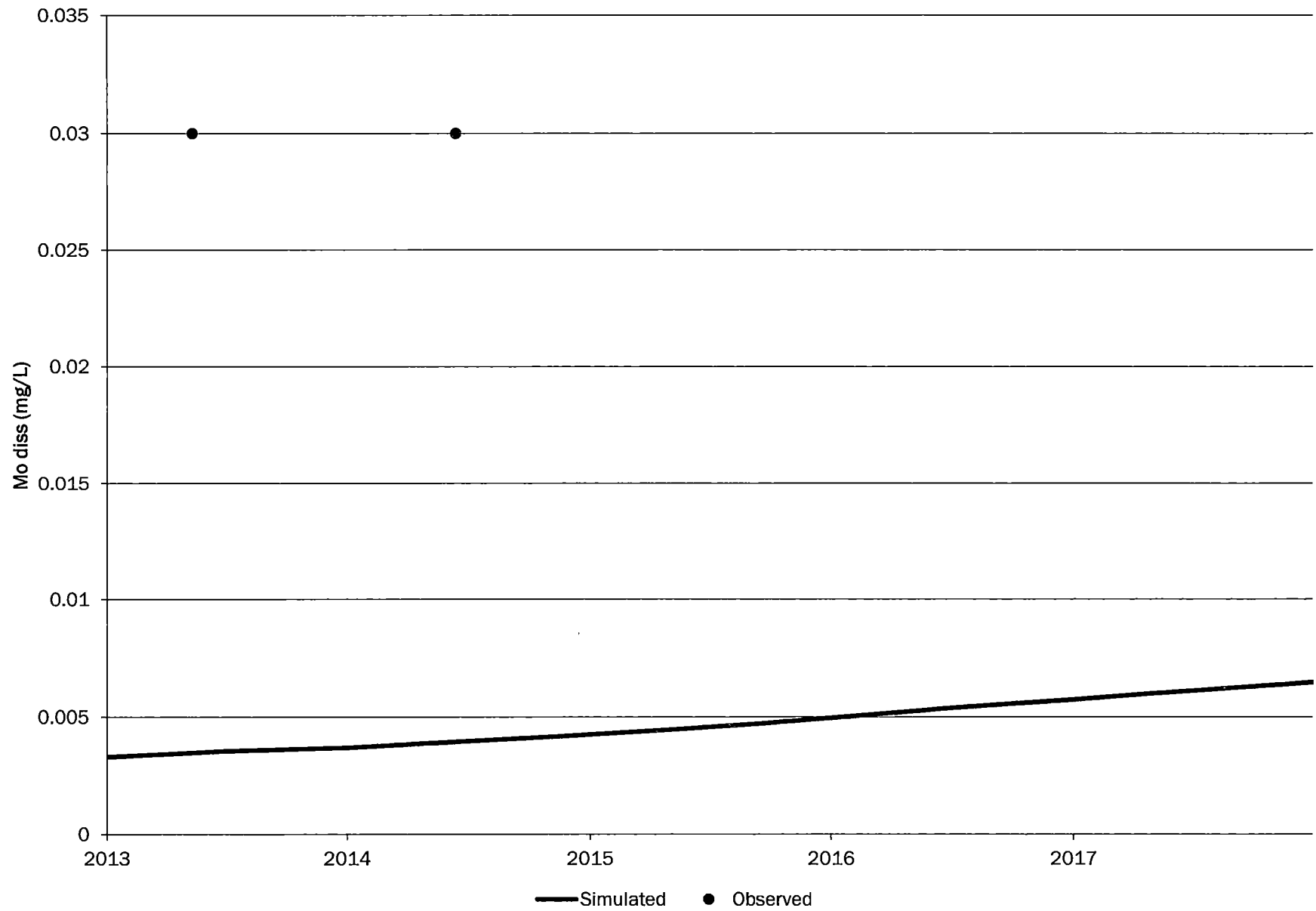
1V-AI



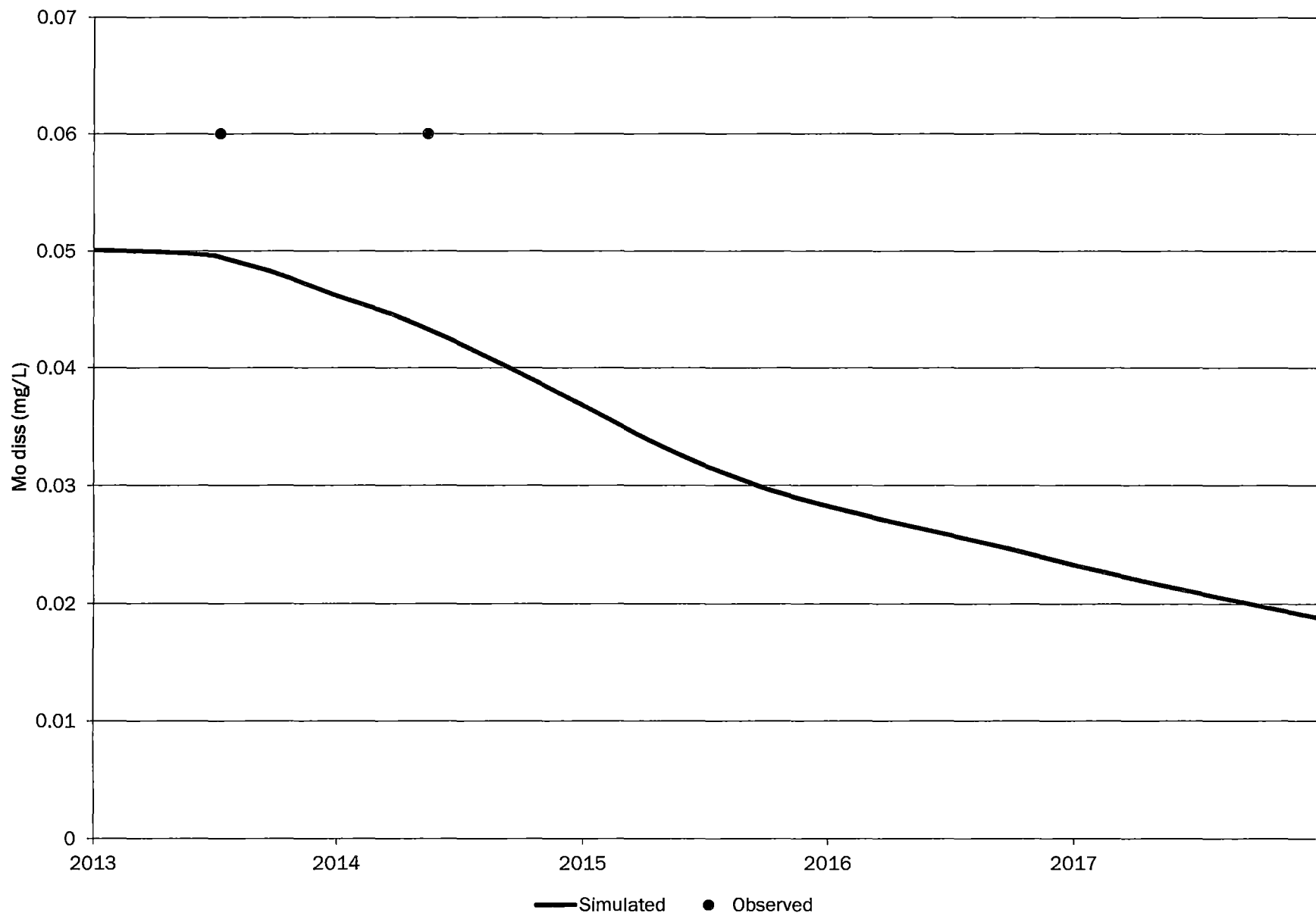
0481-AI



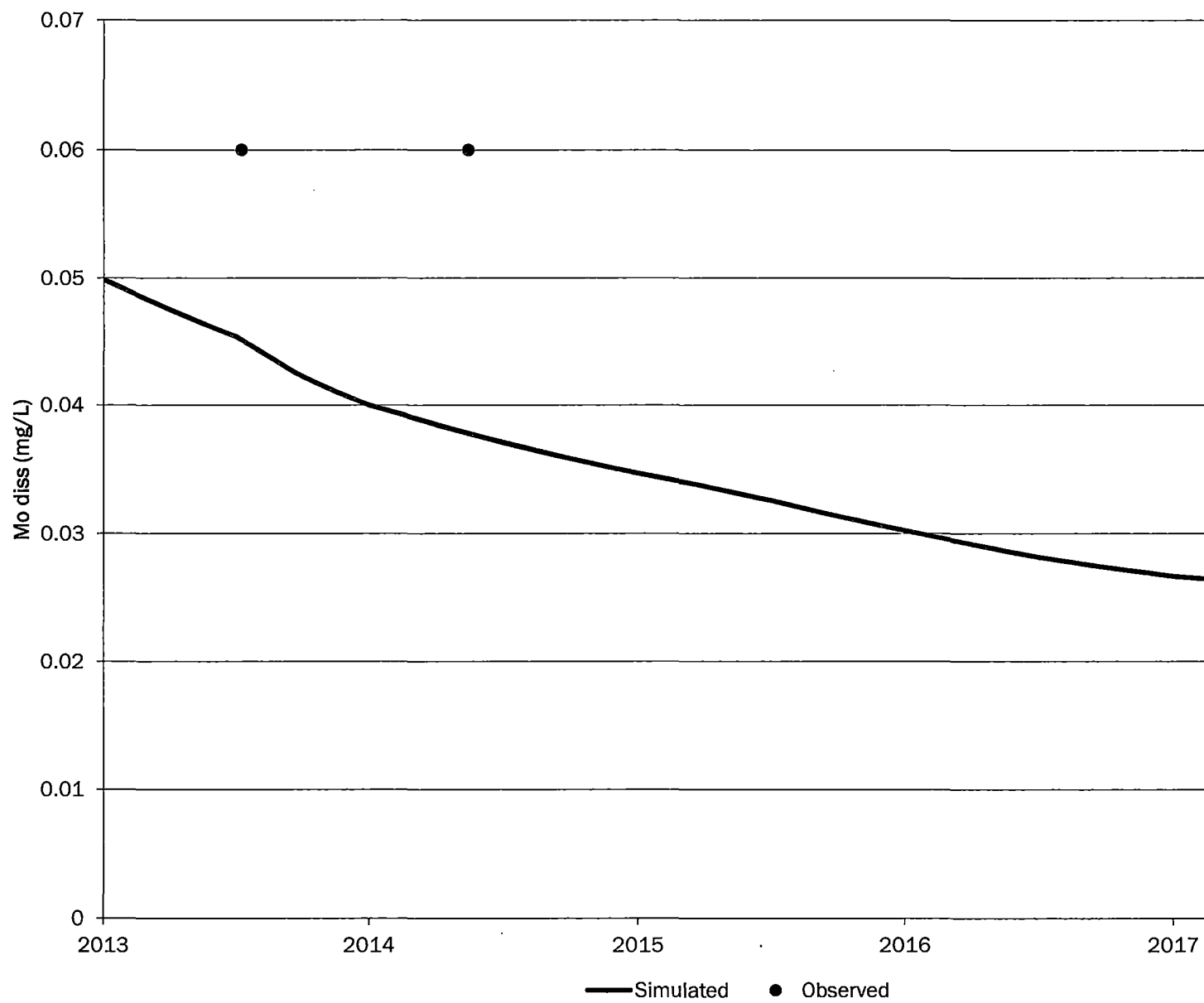
0481-MC



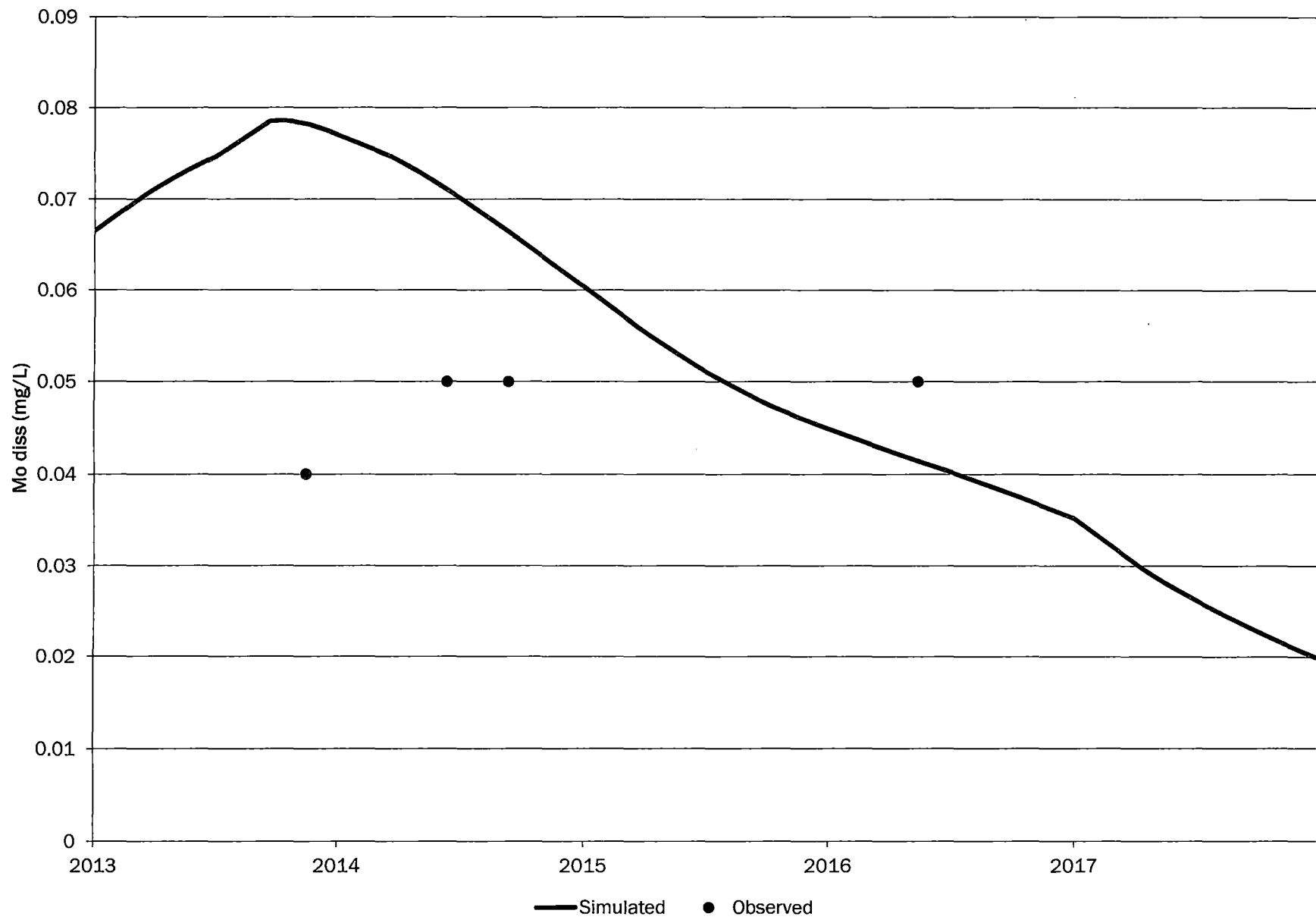
0482-AI



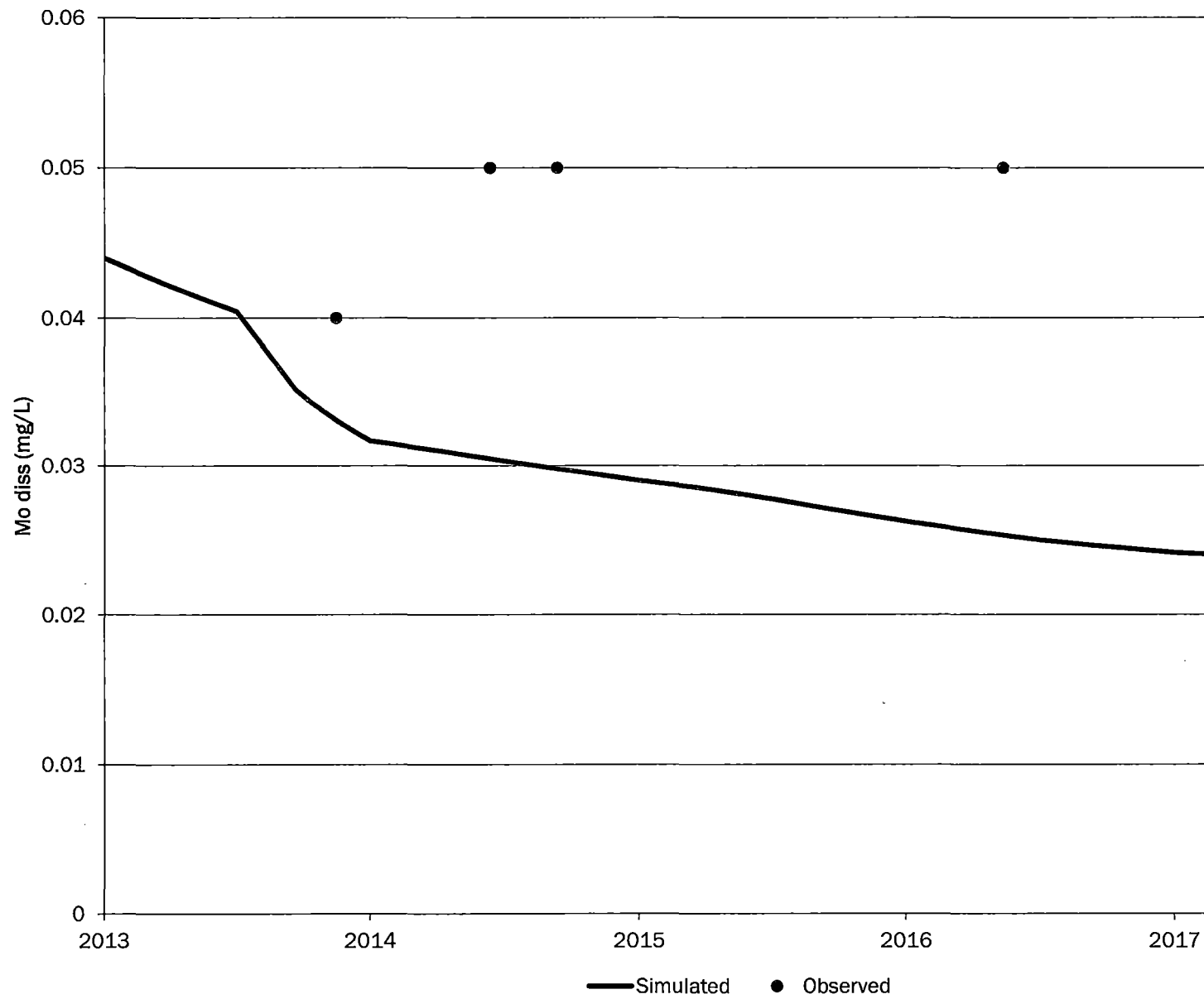
0482-MC



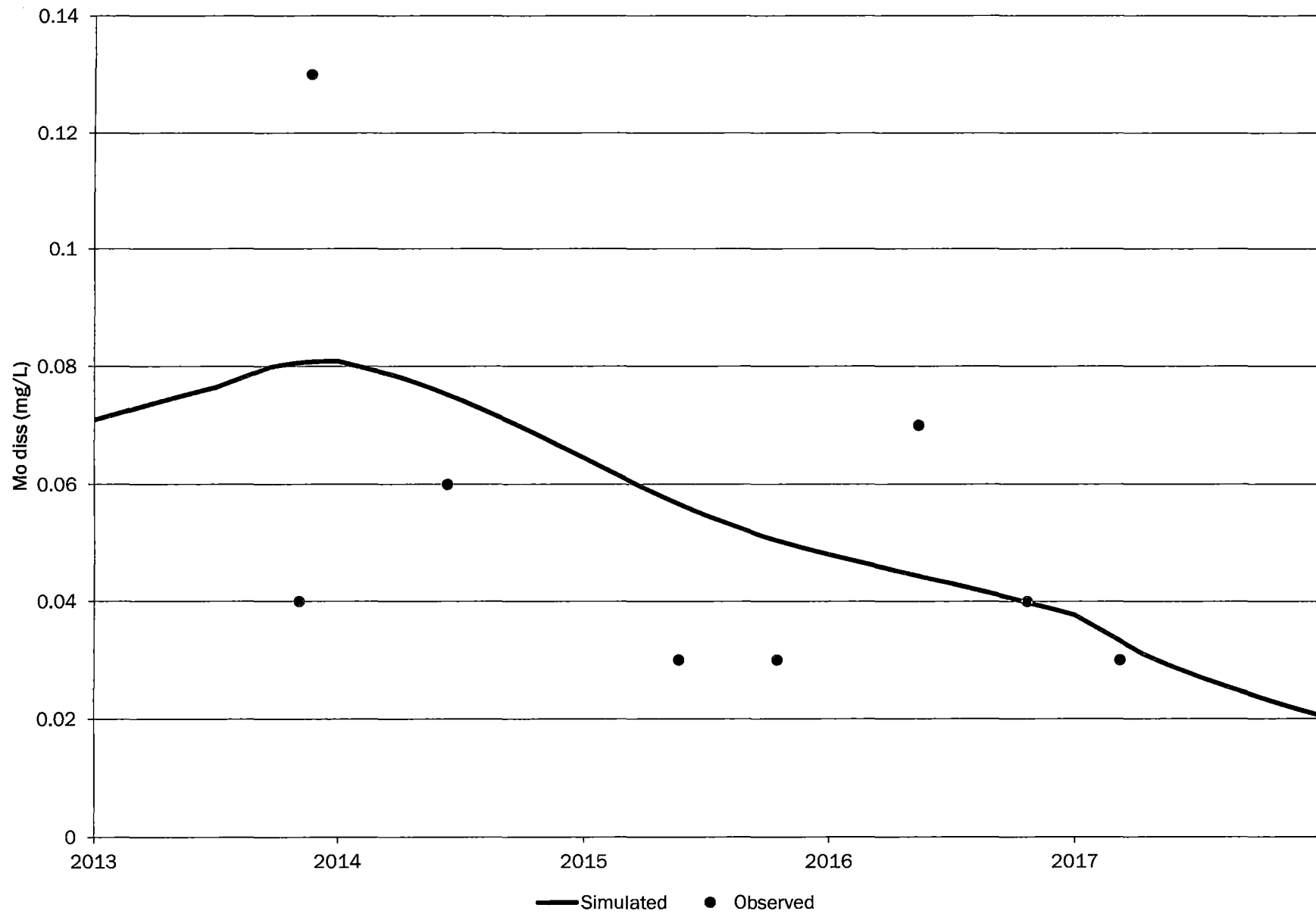
0483-AI



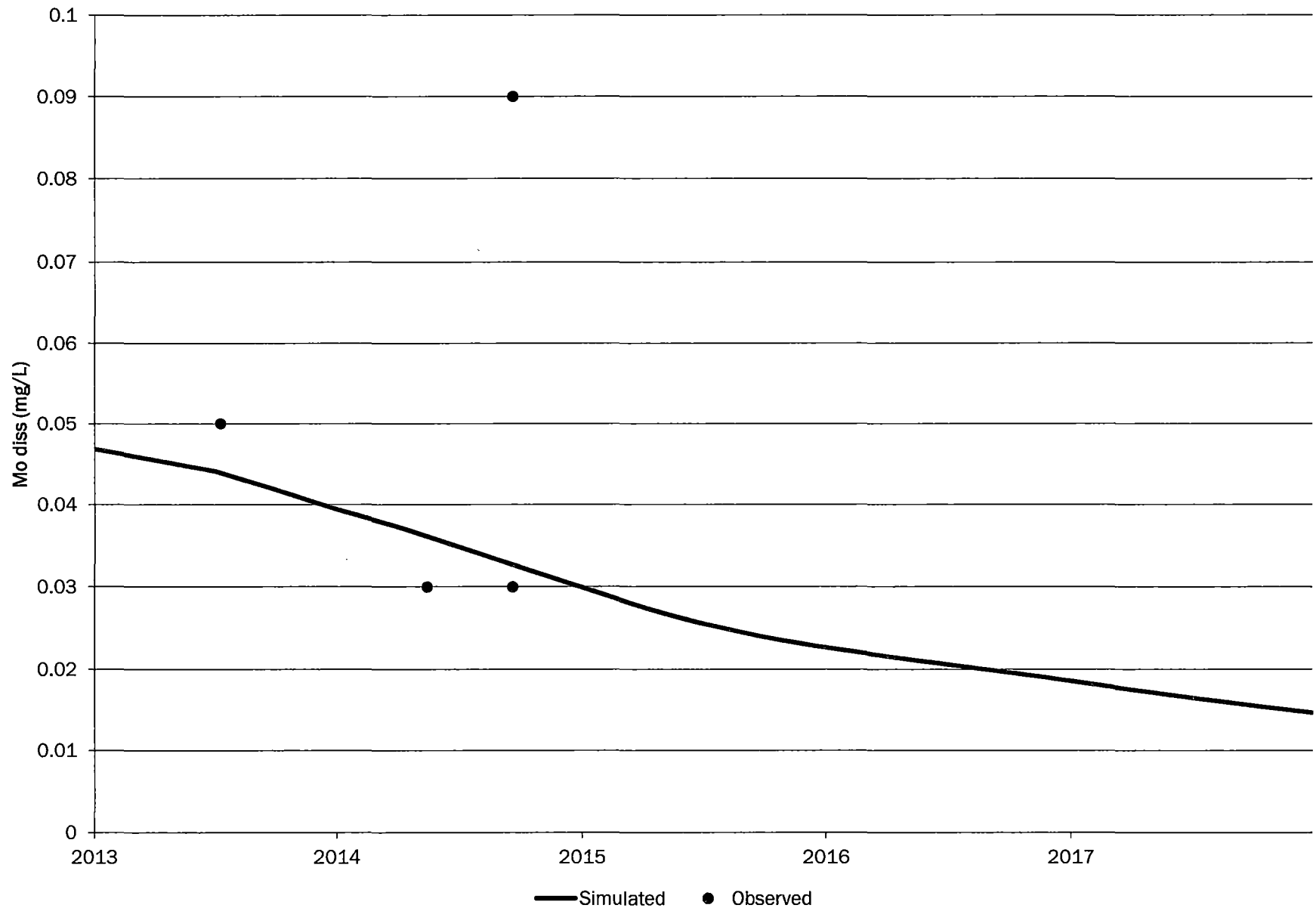
0483-MC



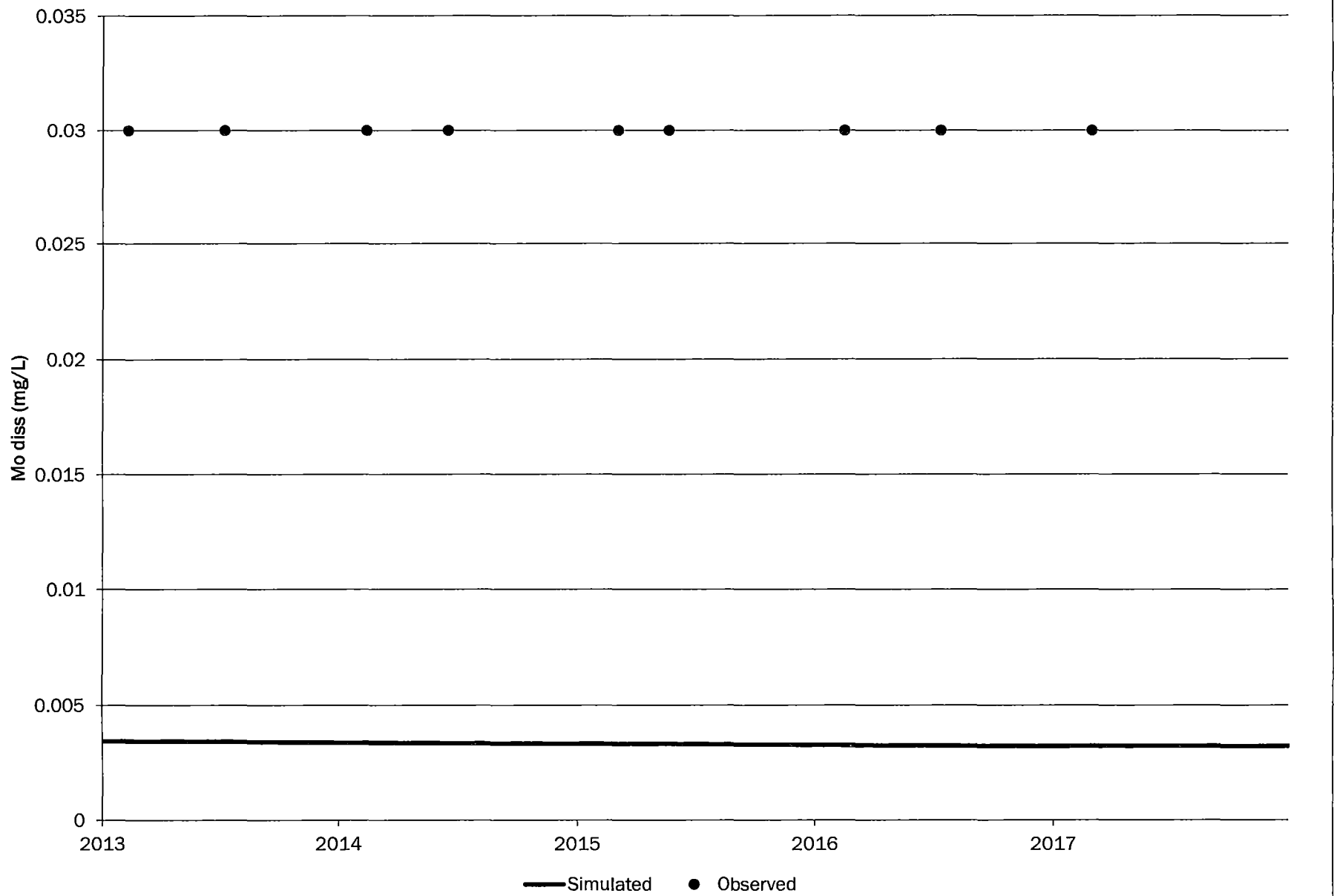
0490-AI



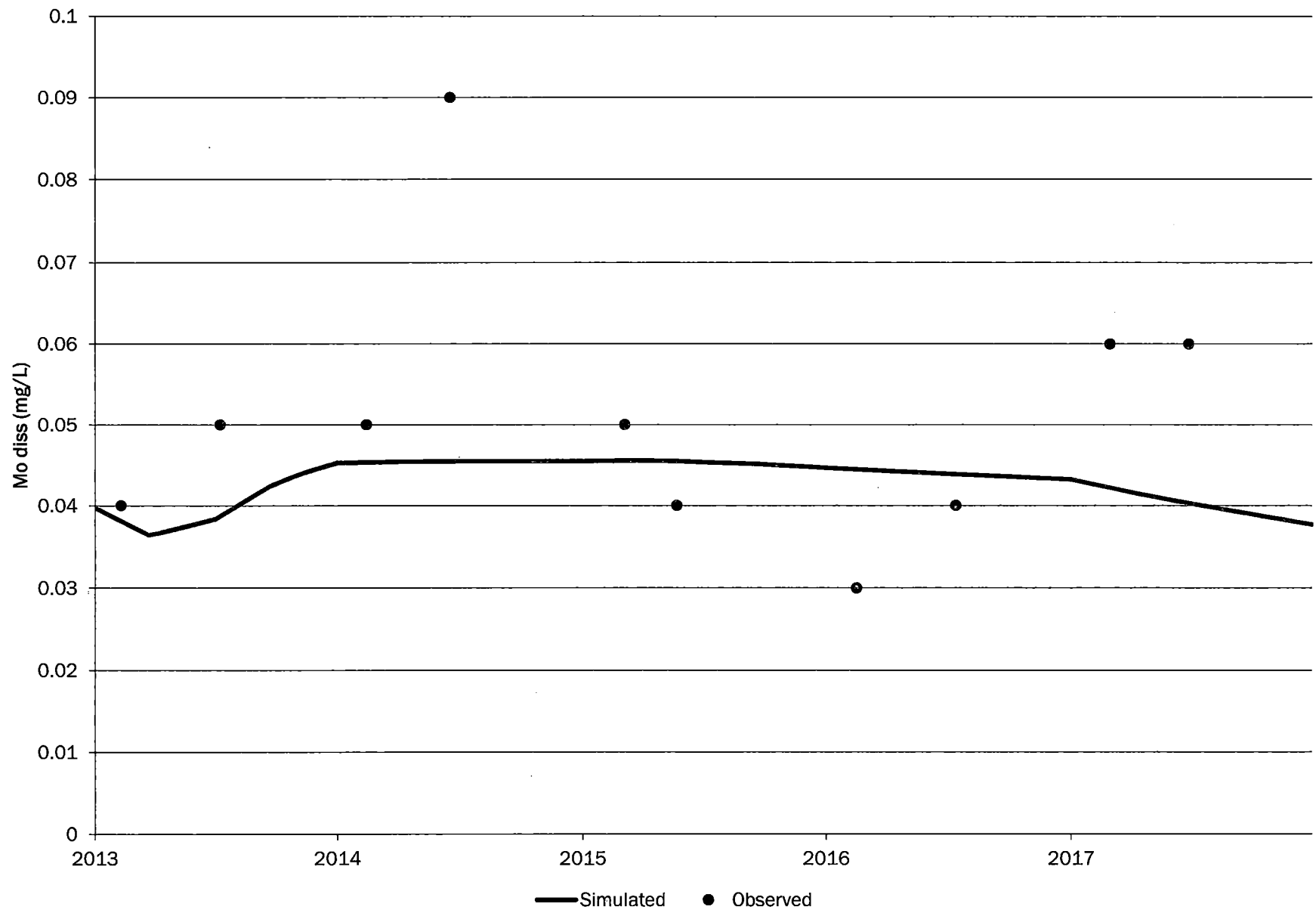
0491-AI



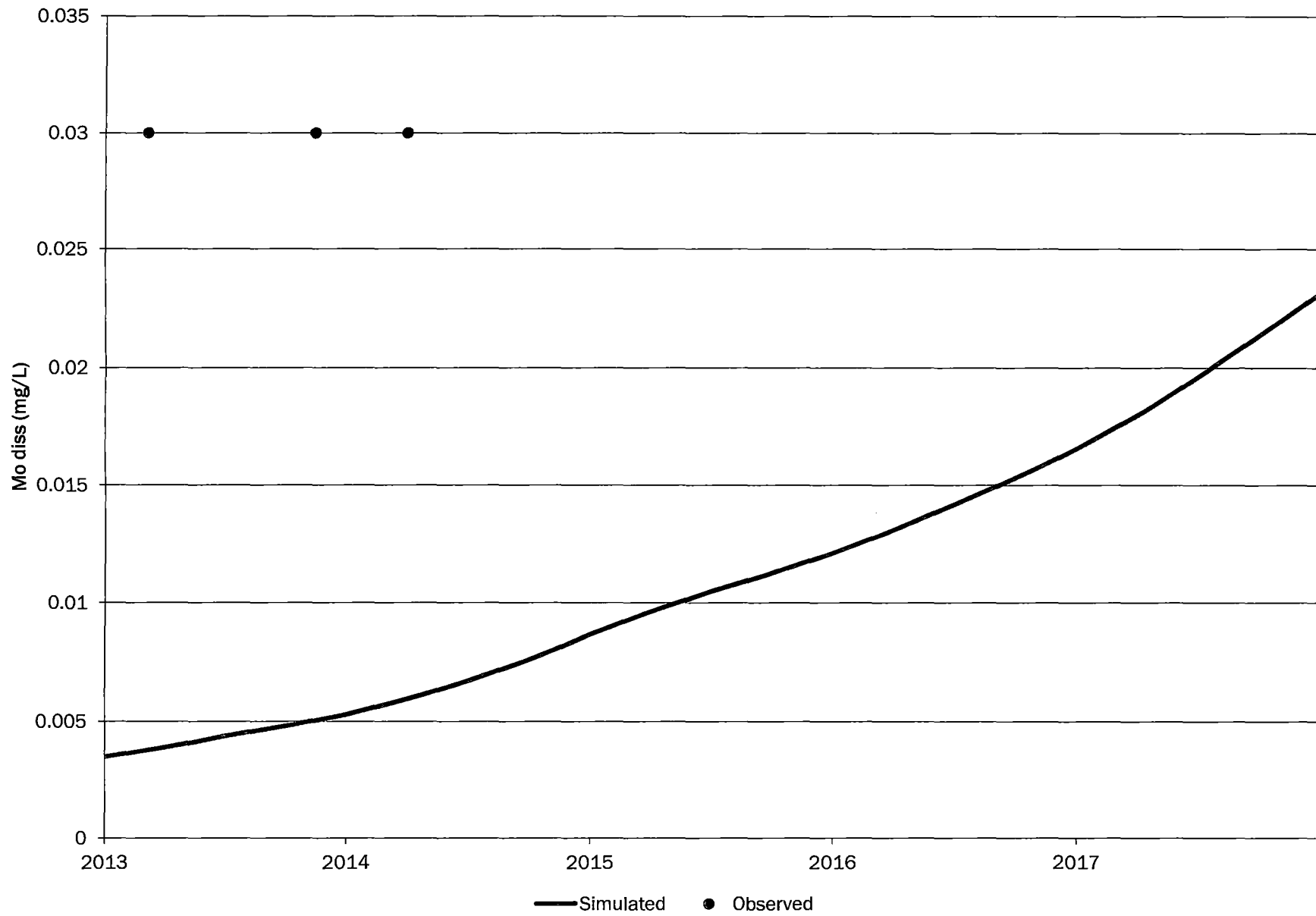
0493-MC



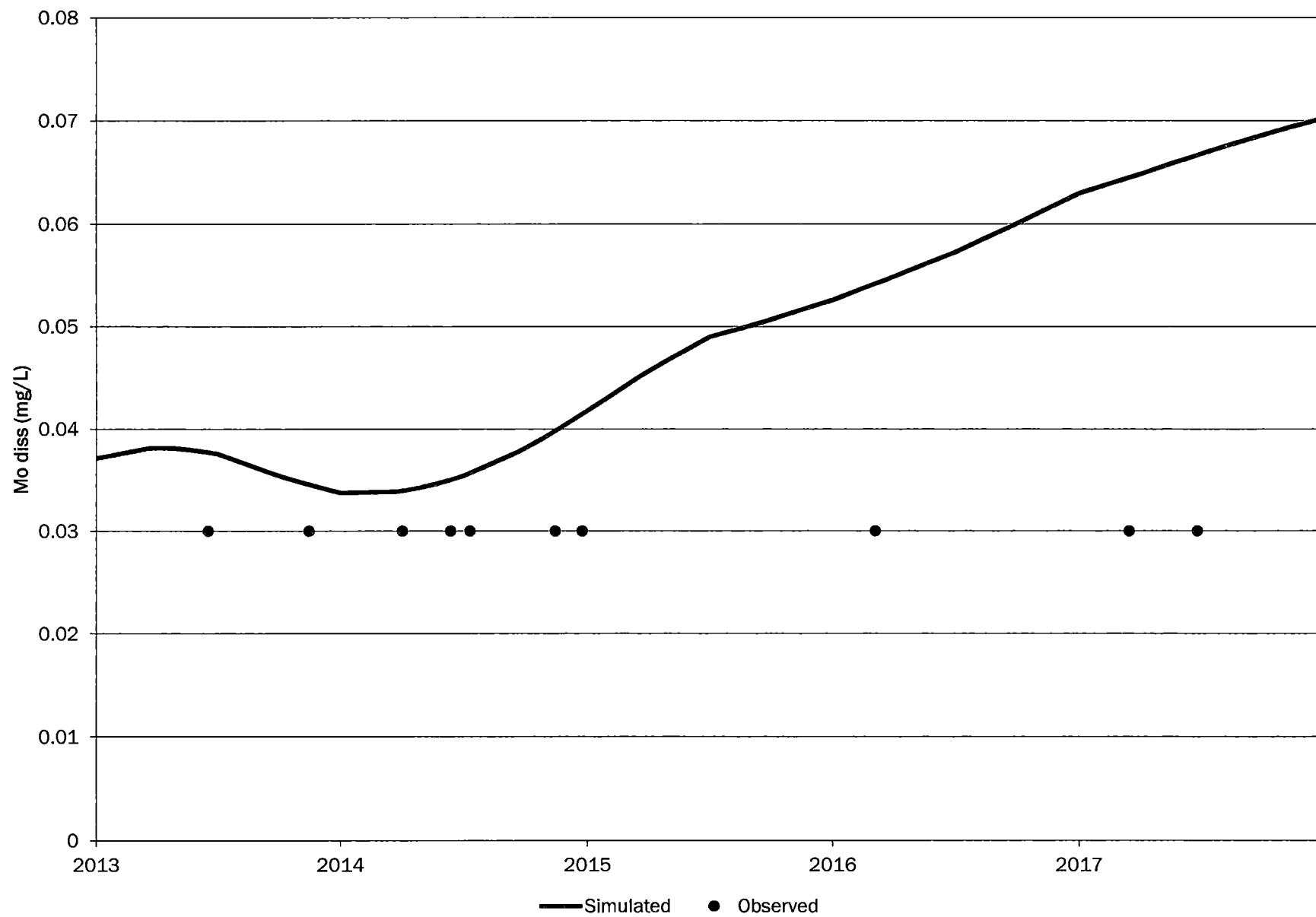
0494-UC



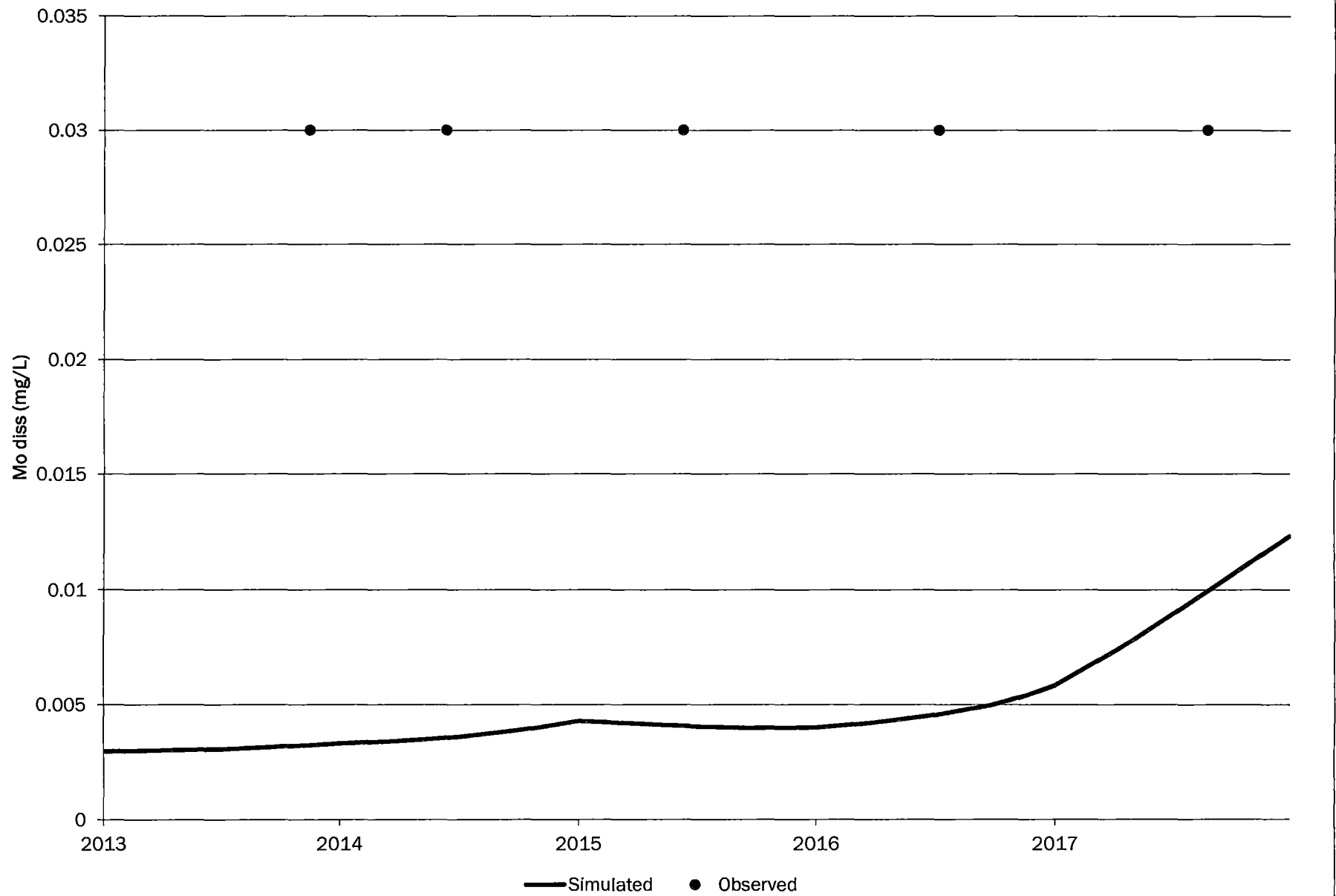
0496-AI



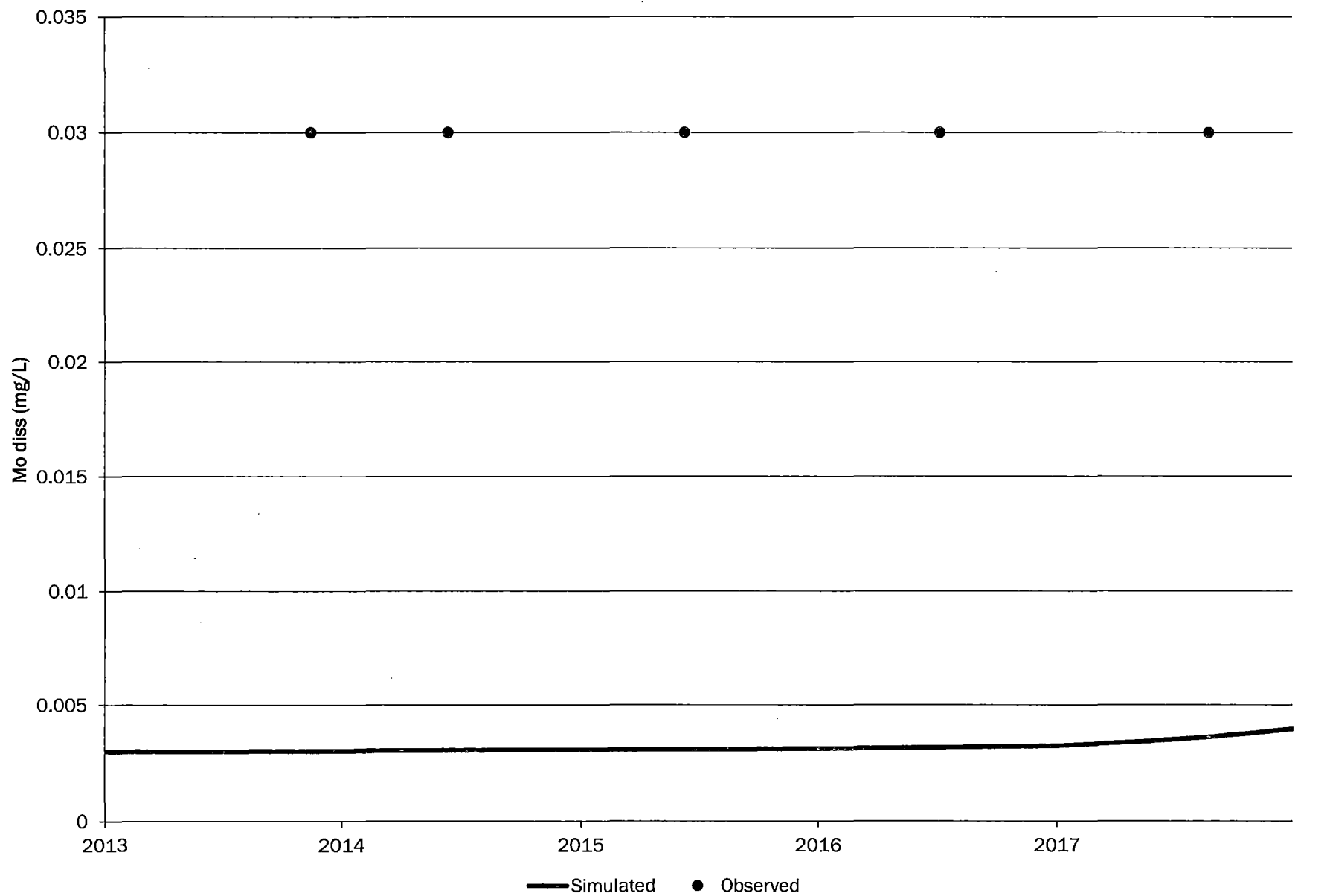
0497-AI



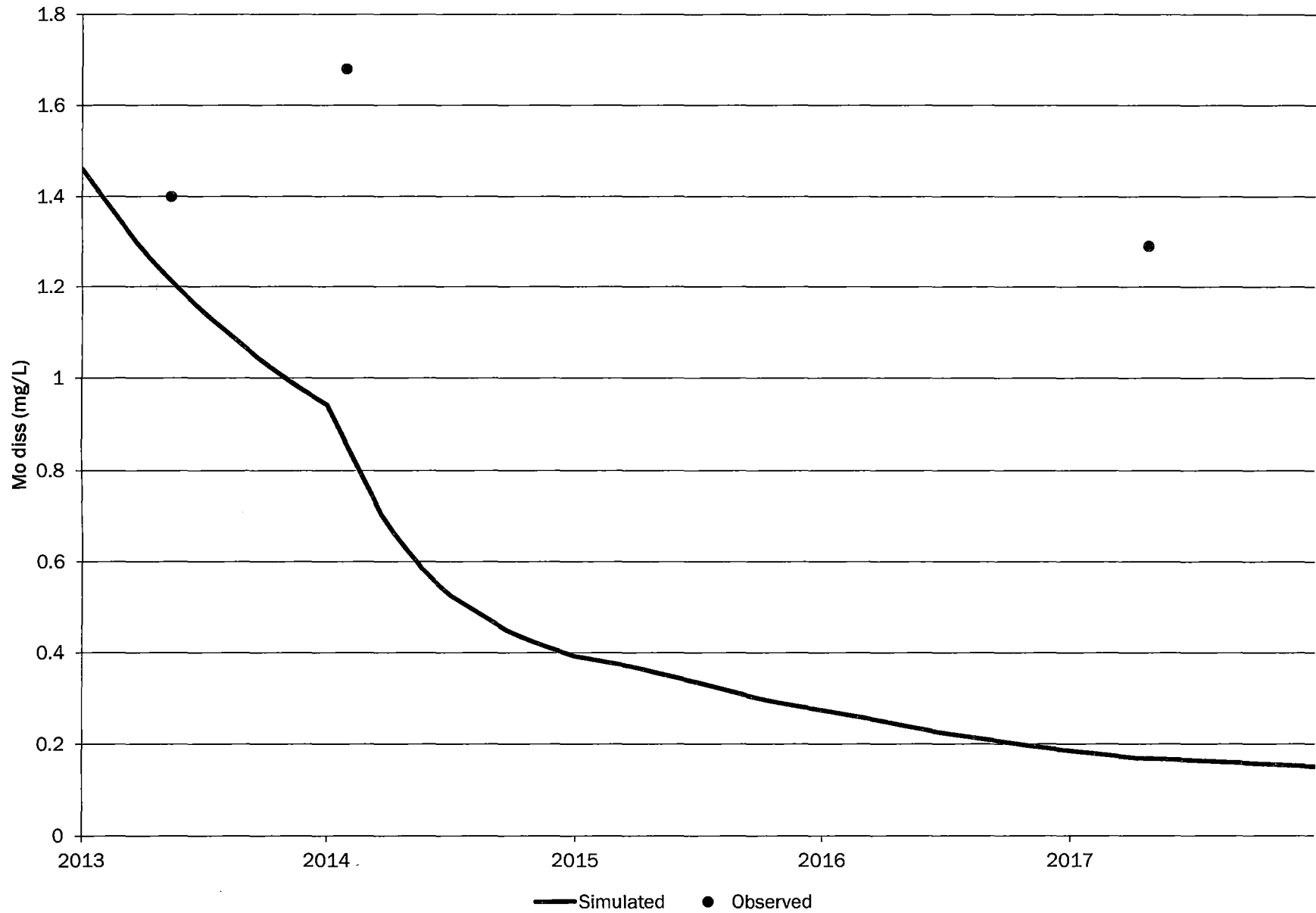
0498-AI



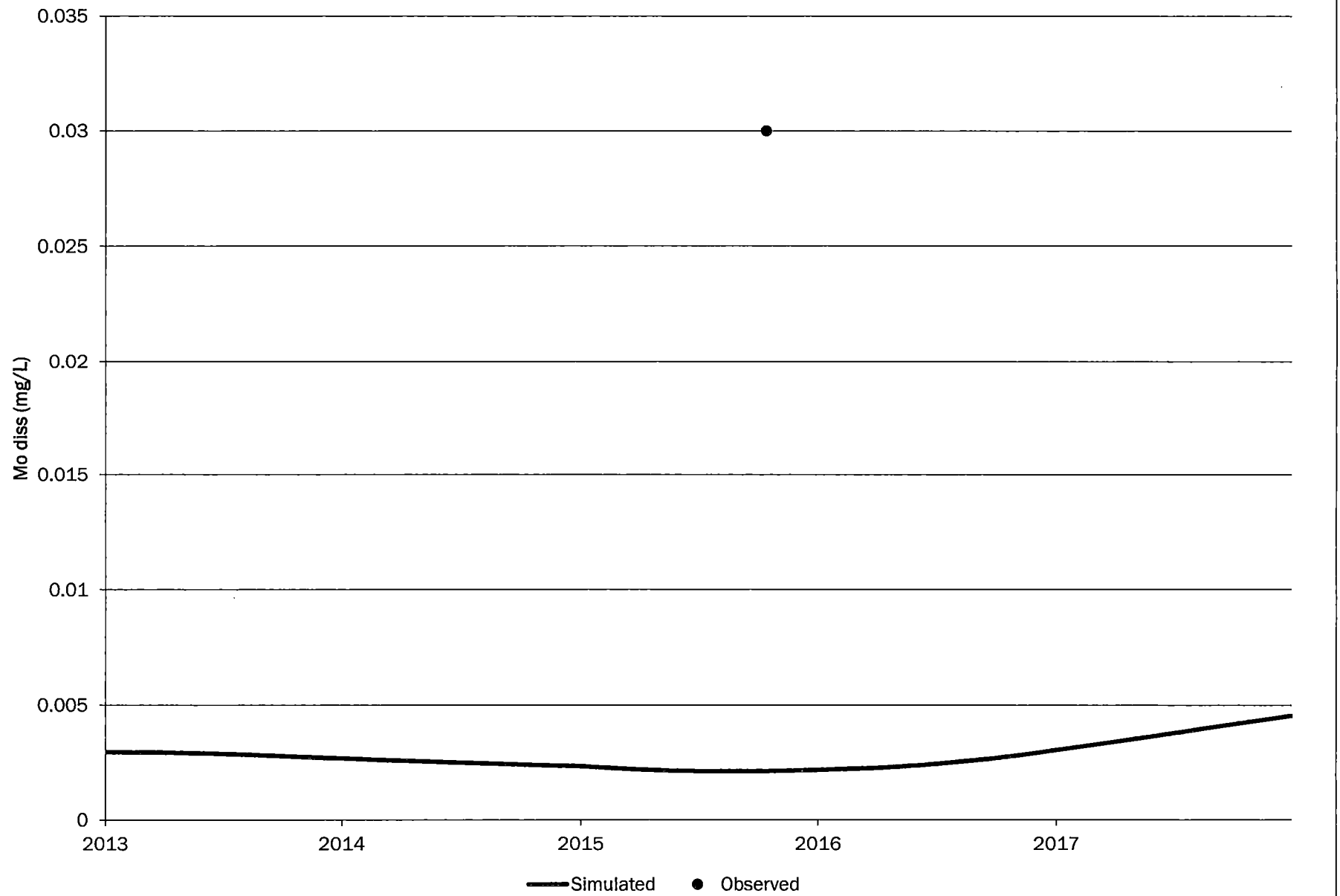
0498-MC



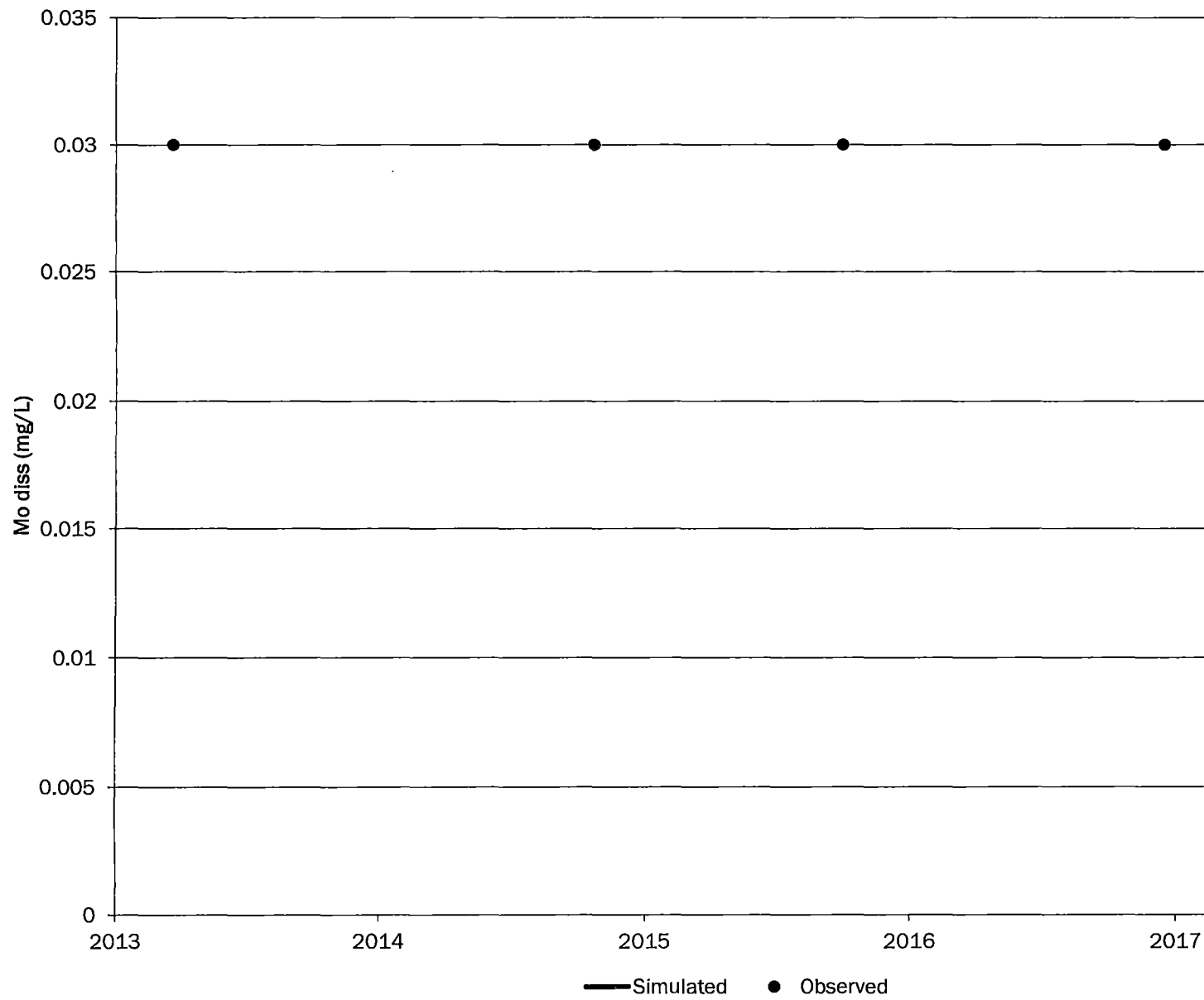
0522-AI



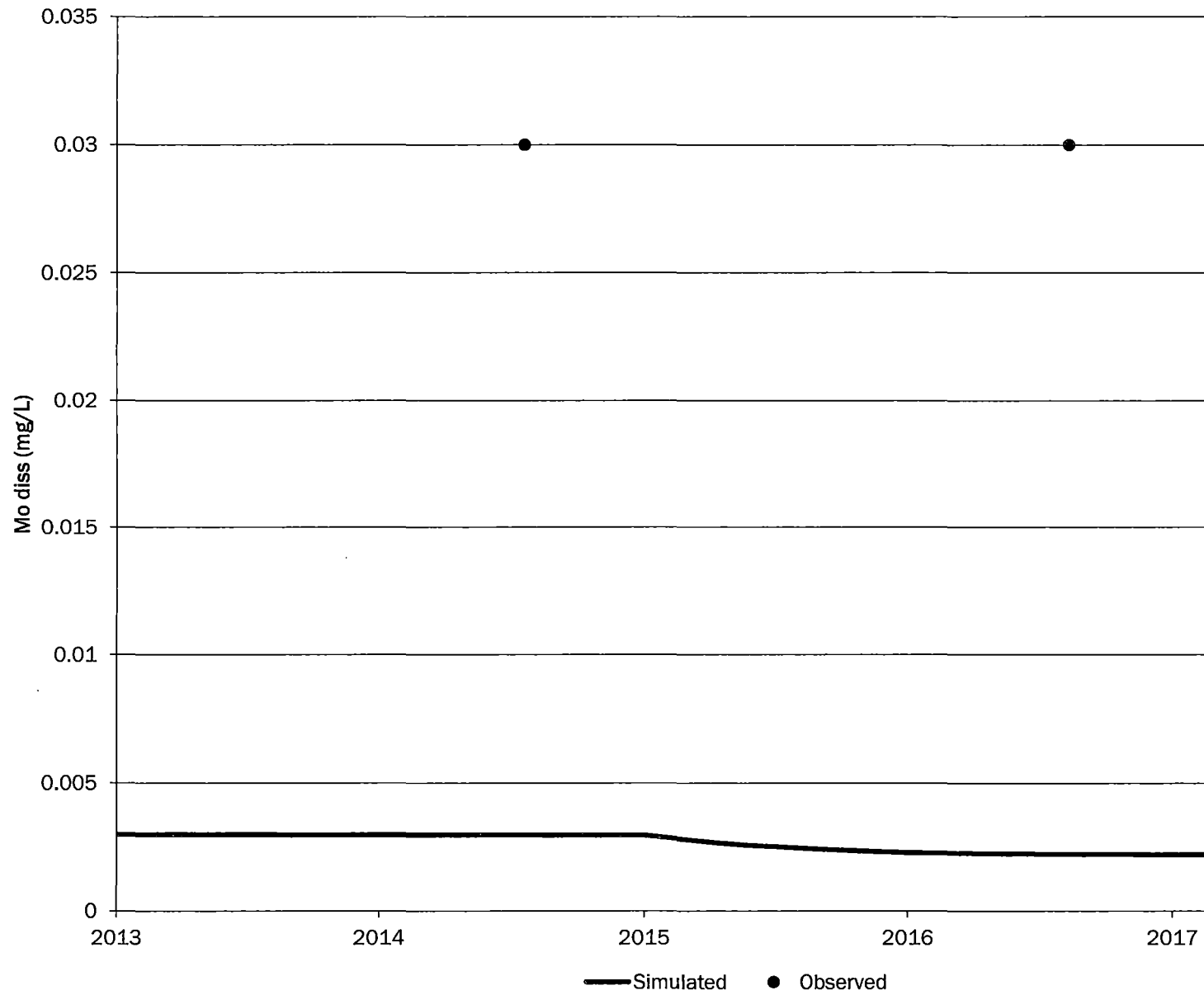
0531-AI



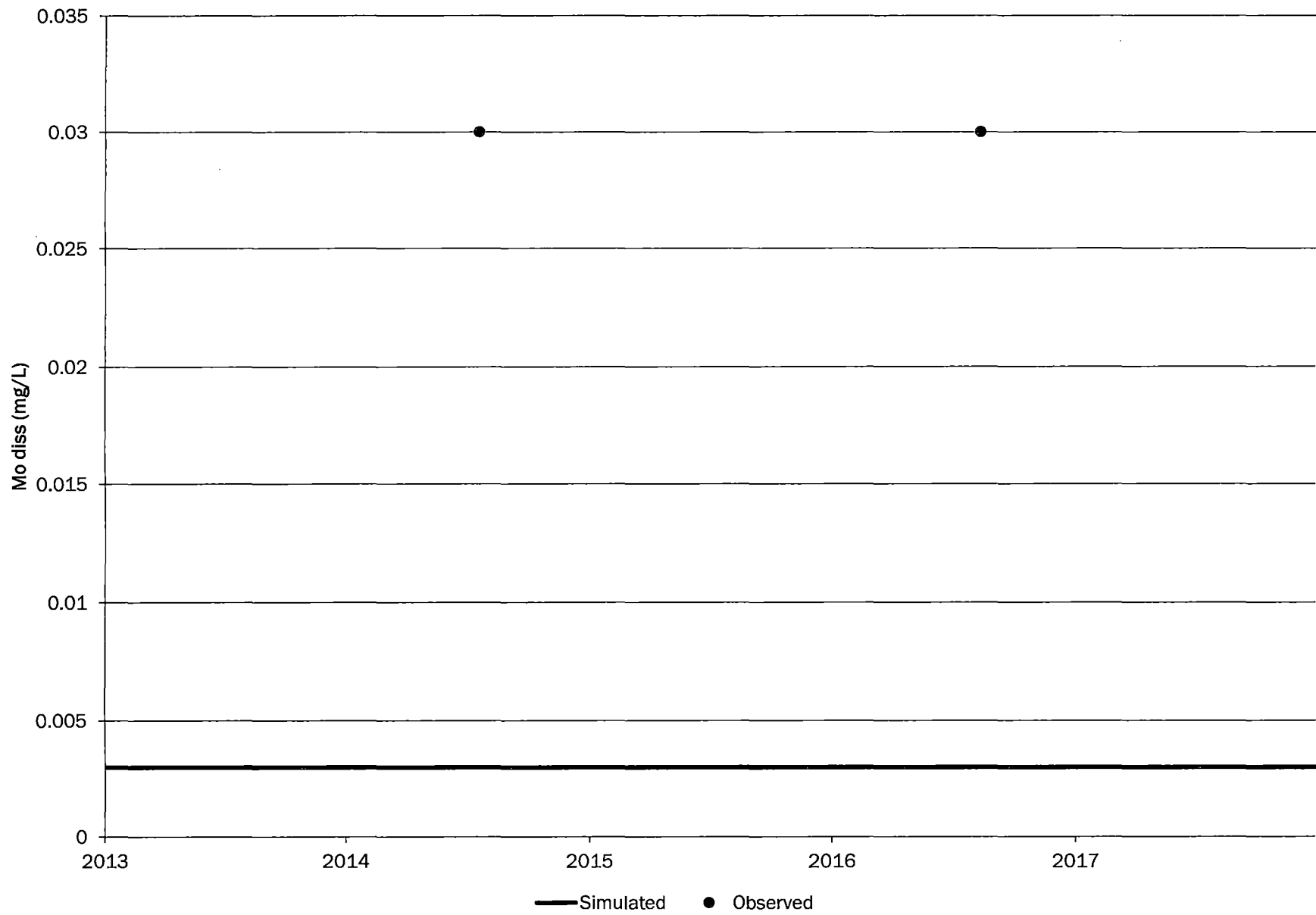
0532-AI



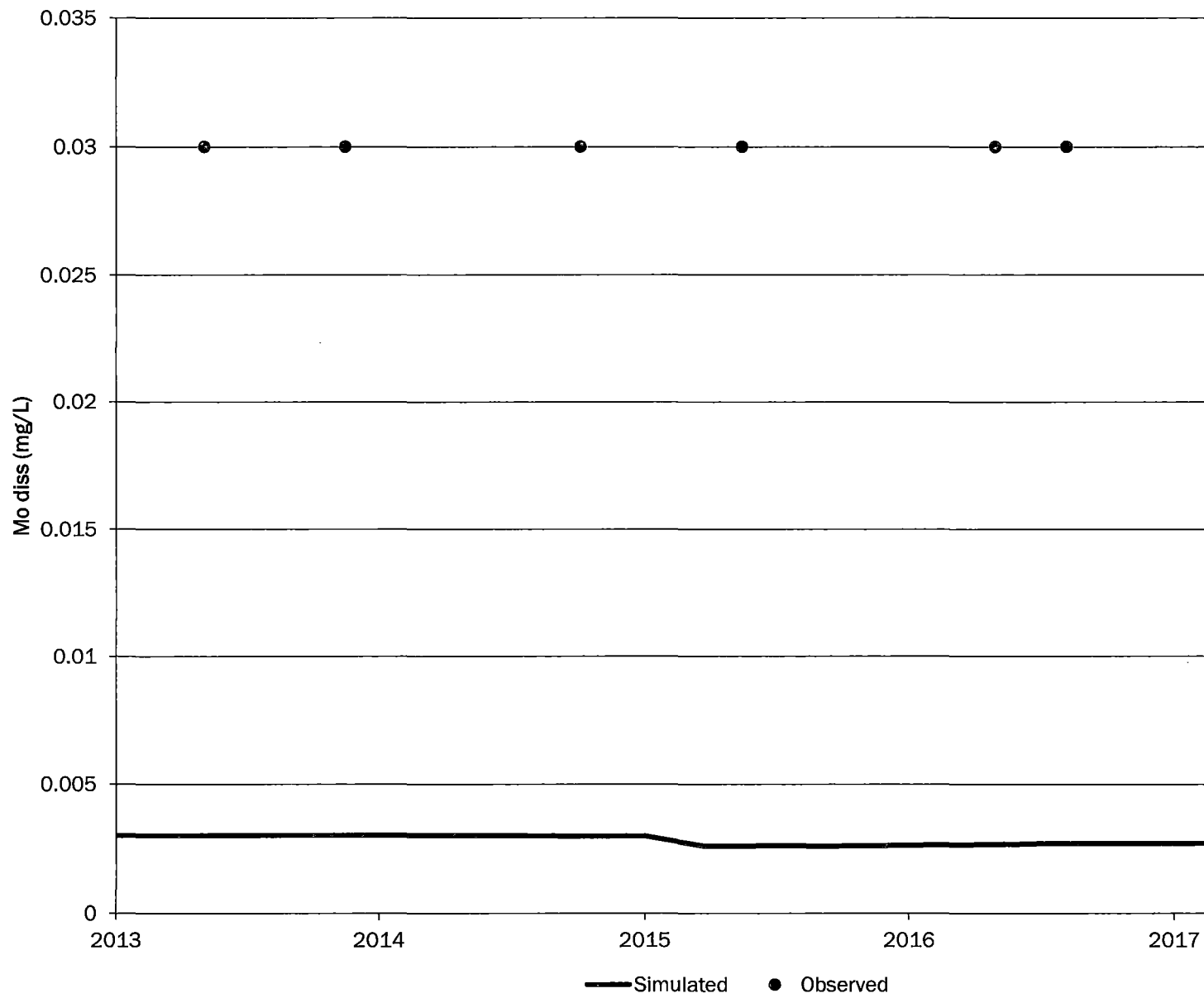
0538-AI



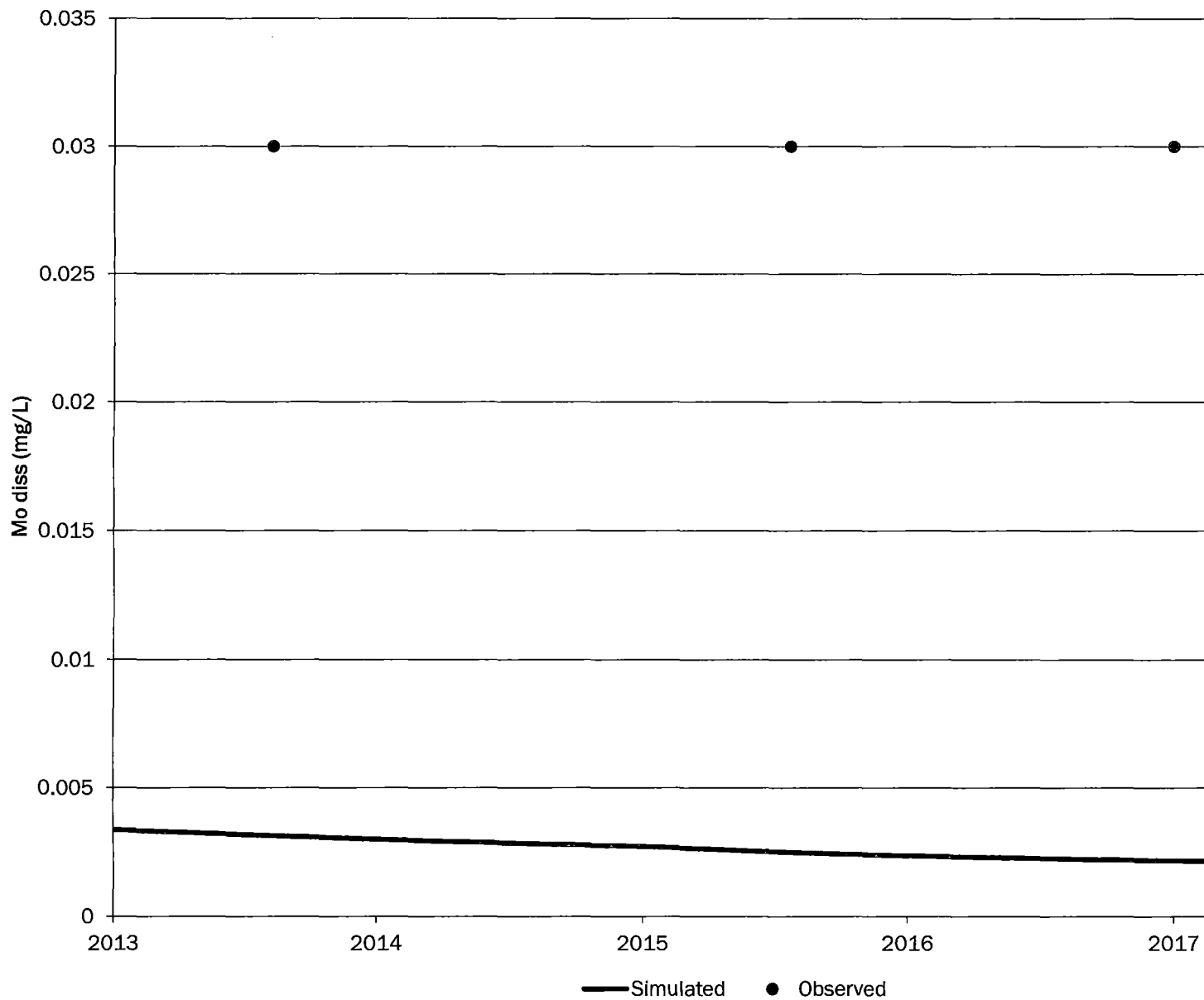
0538-LC



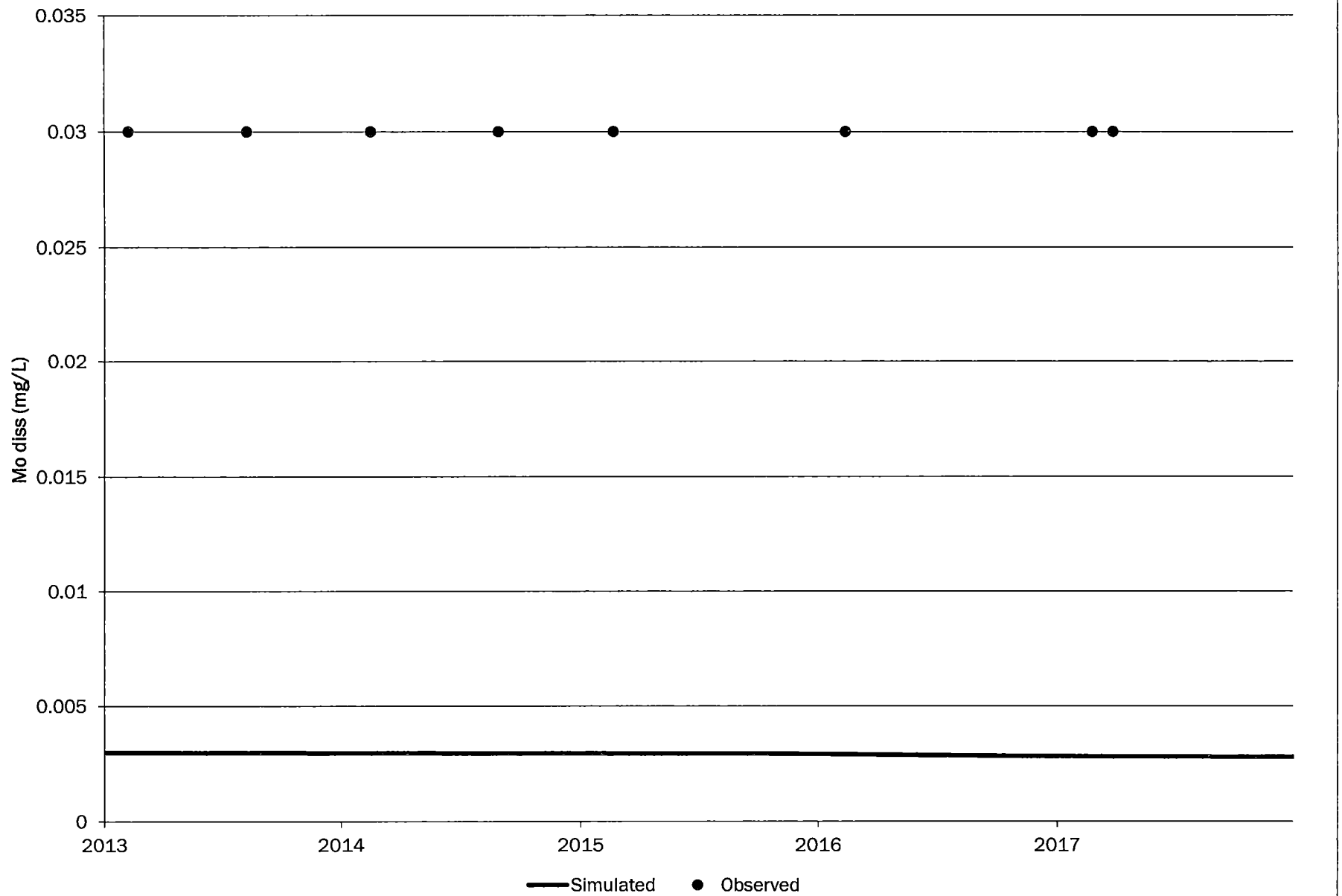
0540-AI



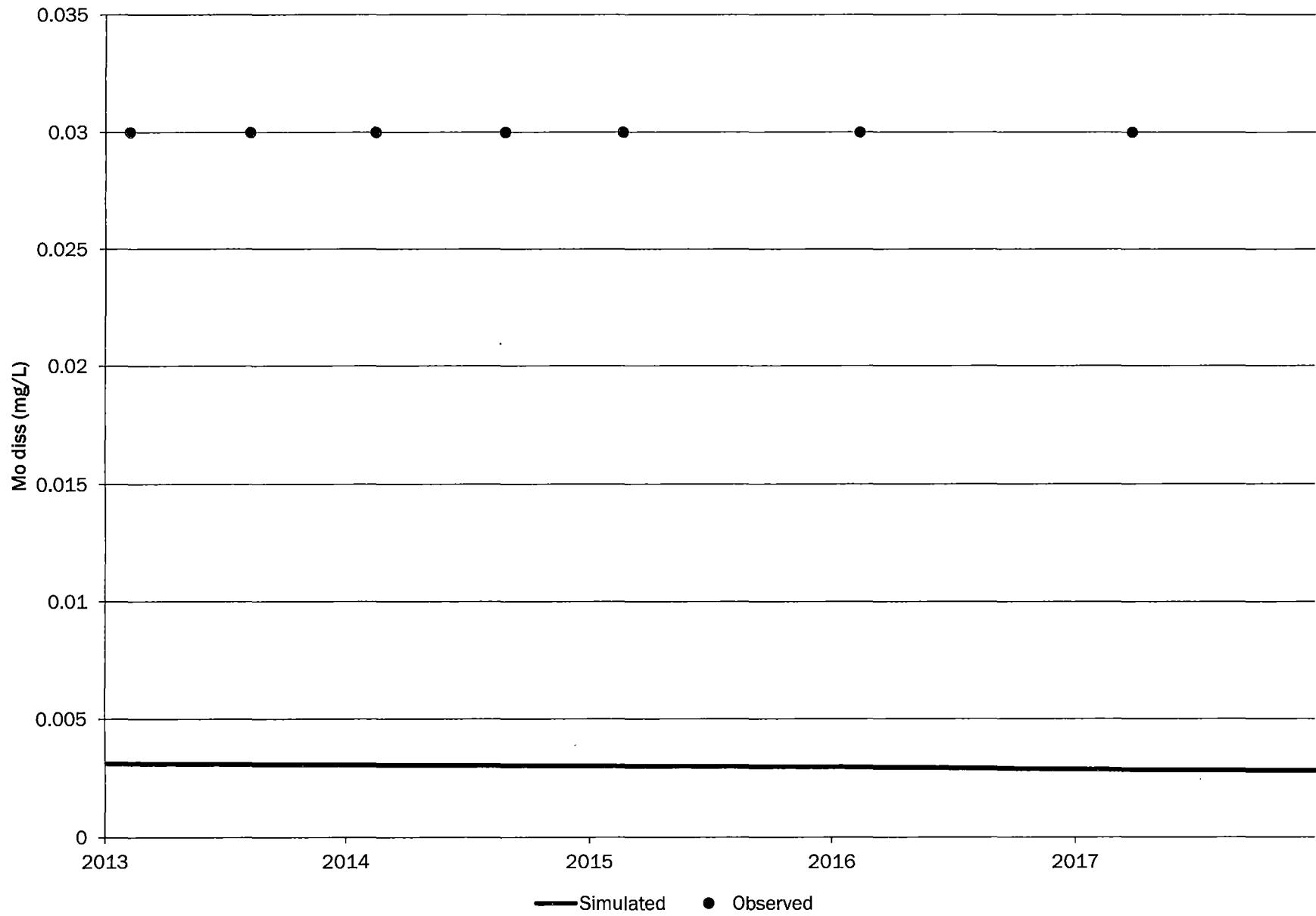
0541-AI



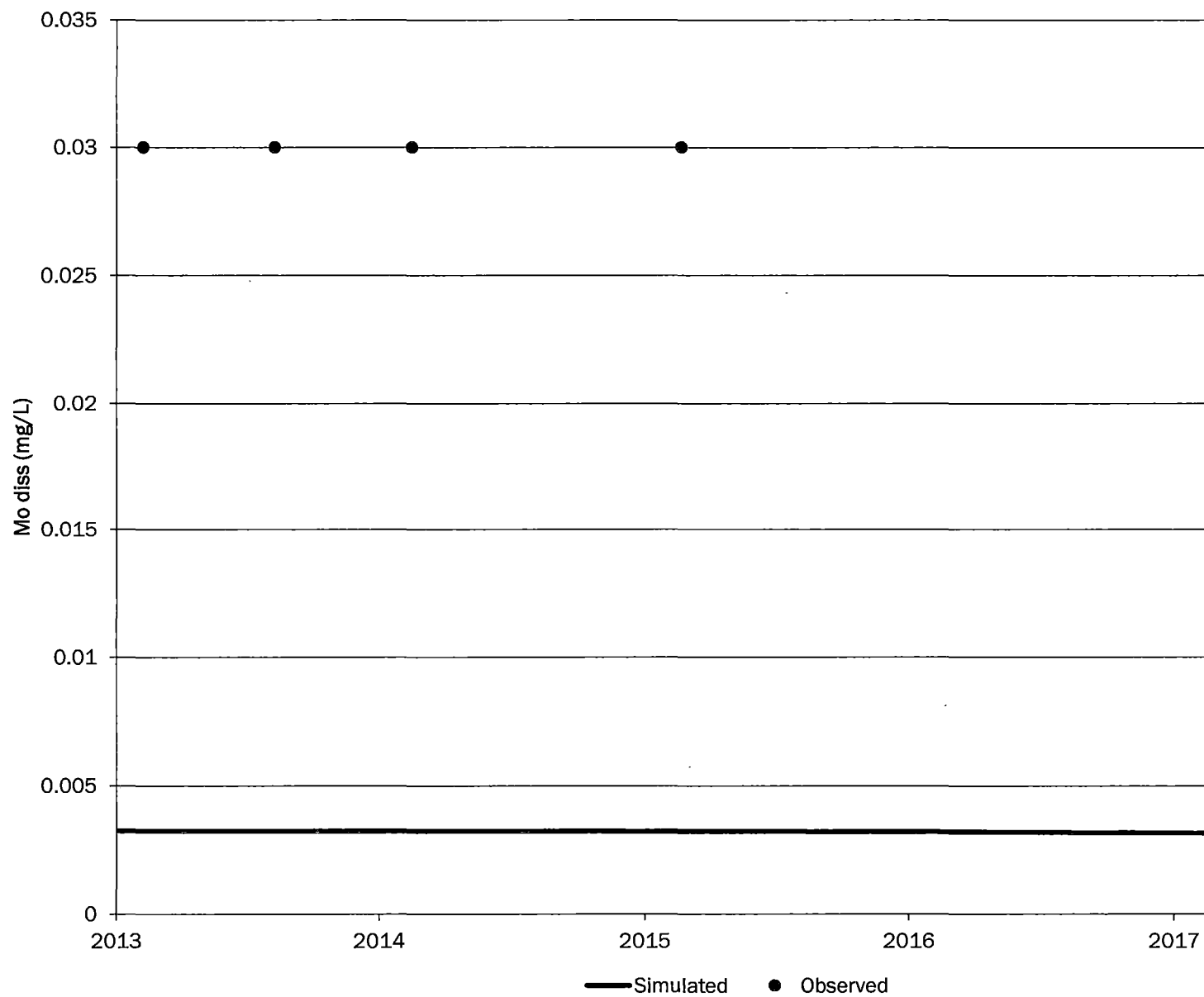
0551-AI



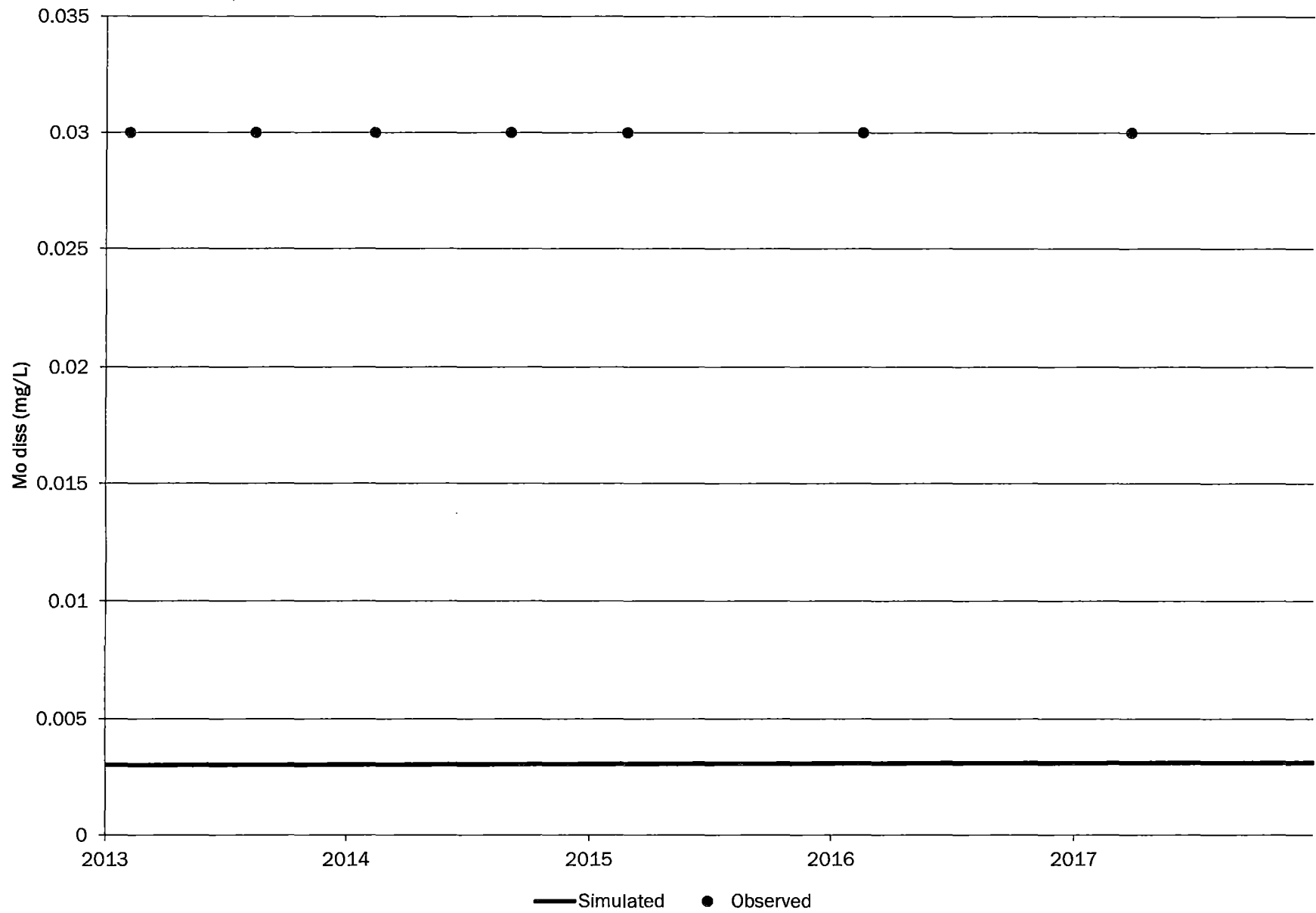
0553-AI



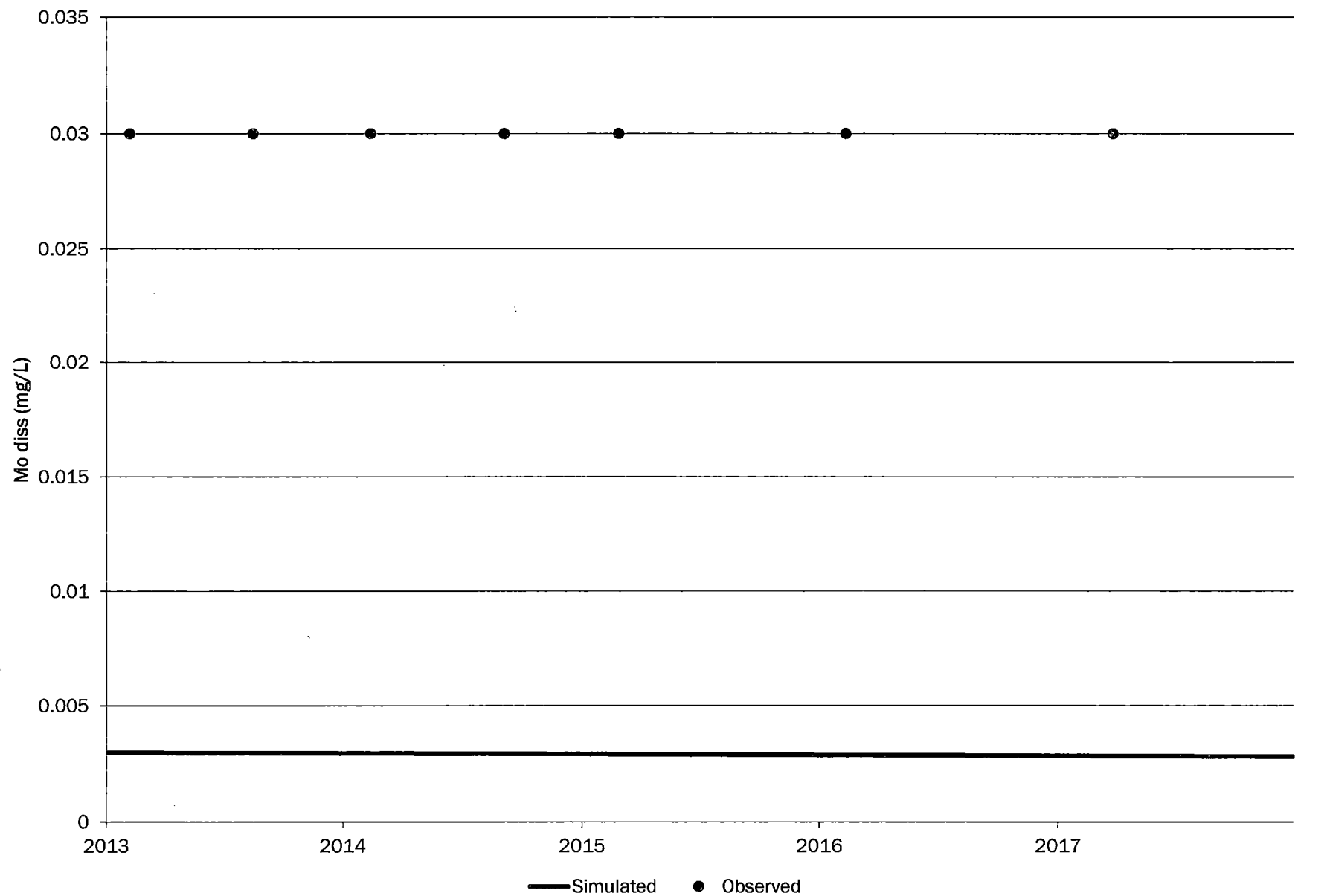
0554-AI



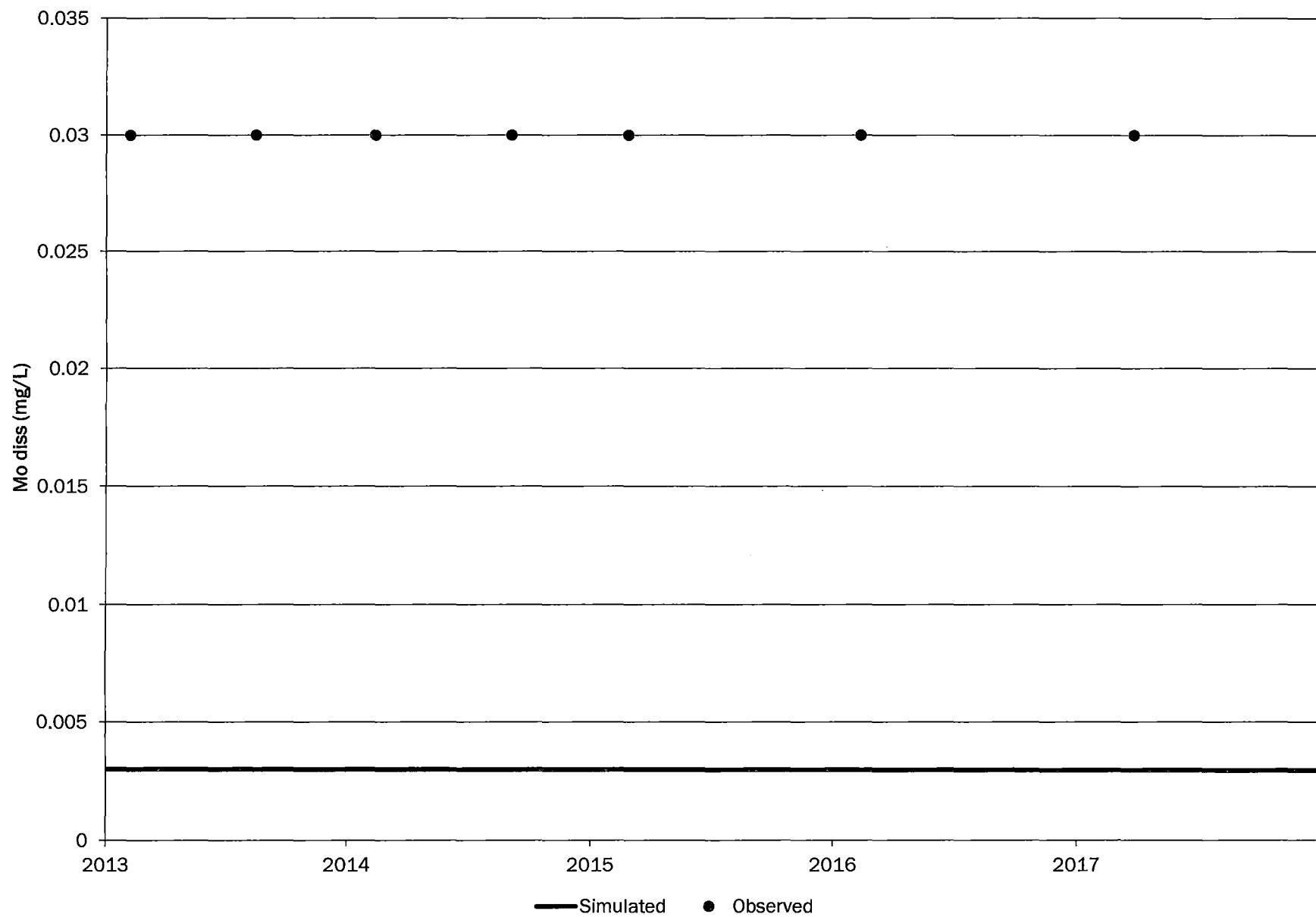
0555-AI



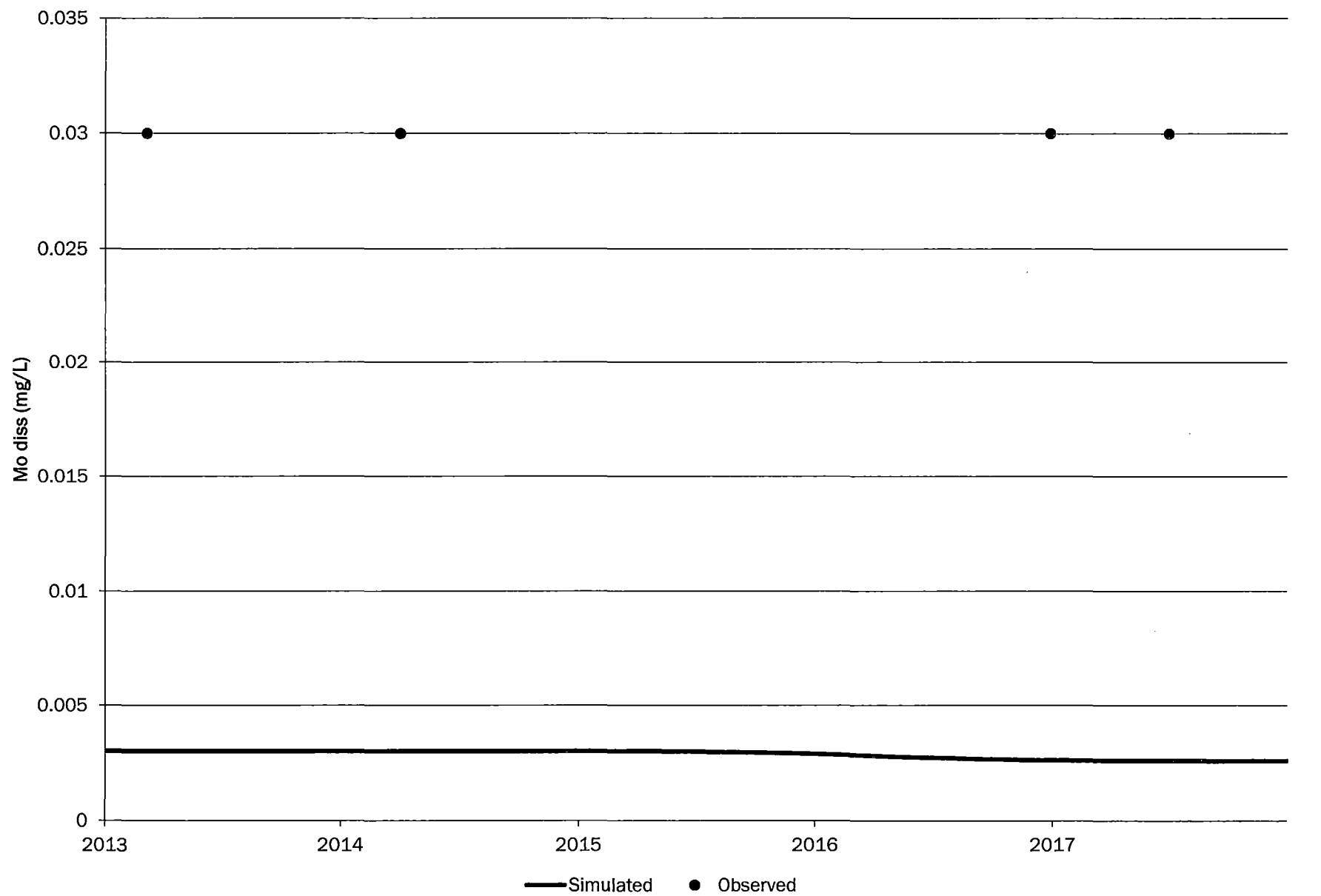
0556-AI



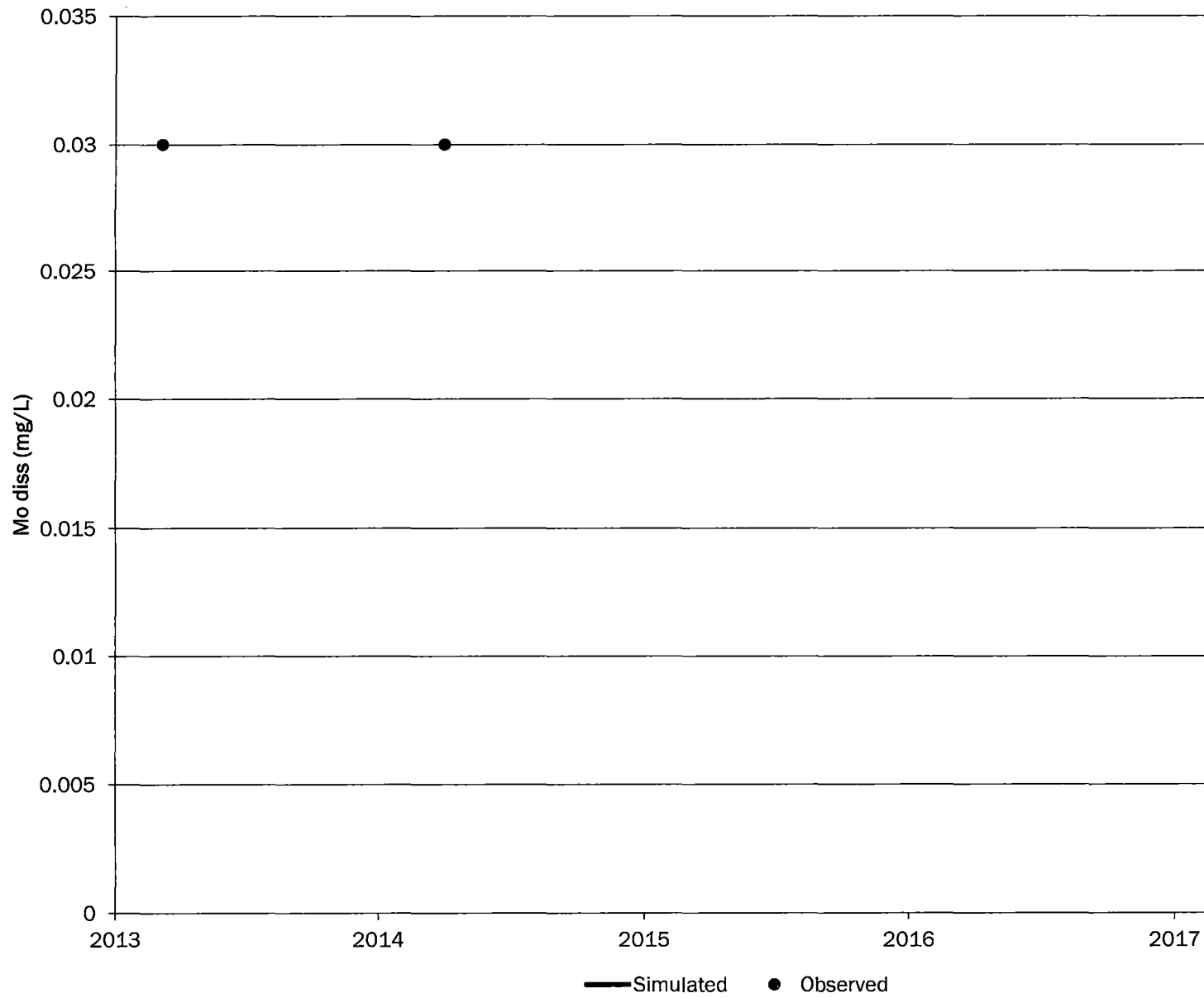
0557-AI



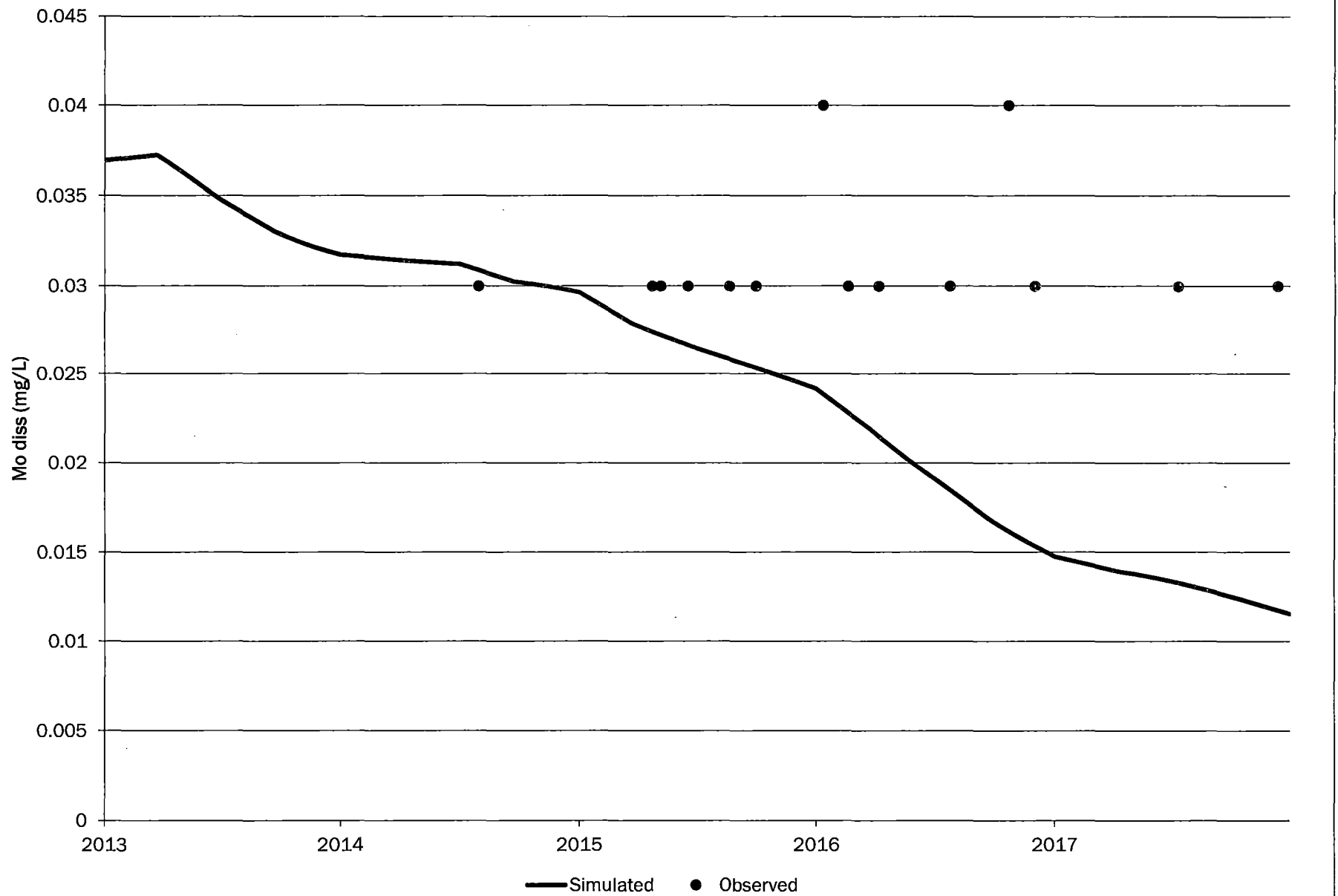
0631-AI



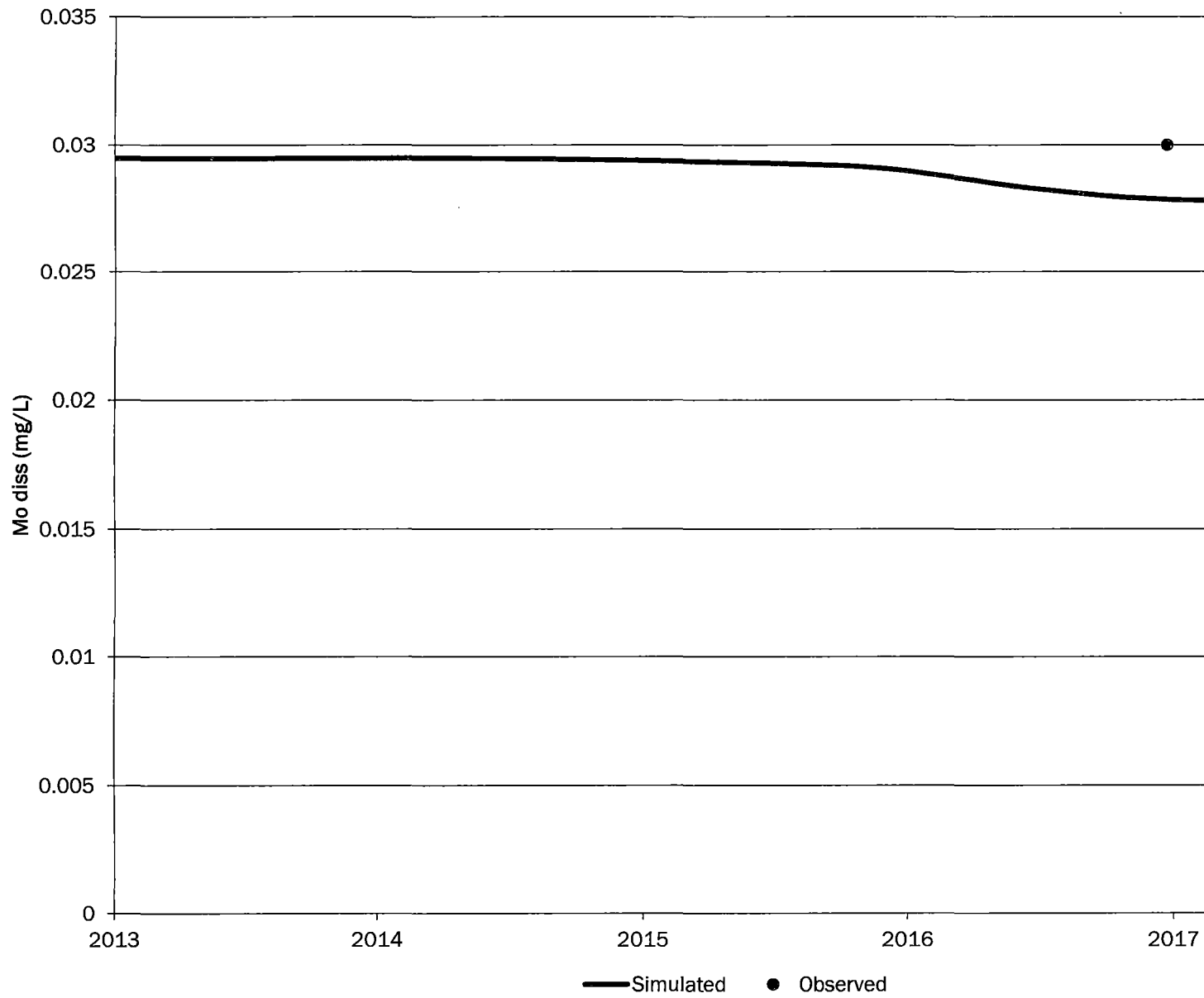
0632-AI



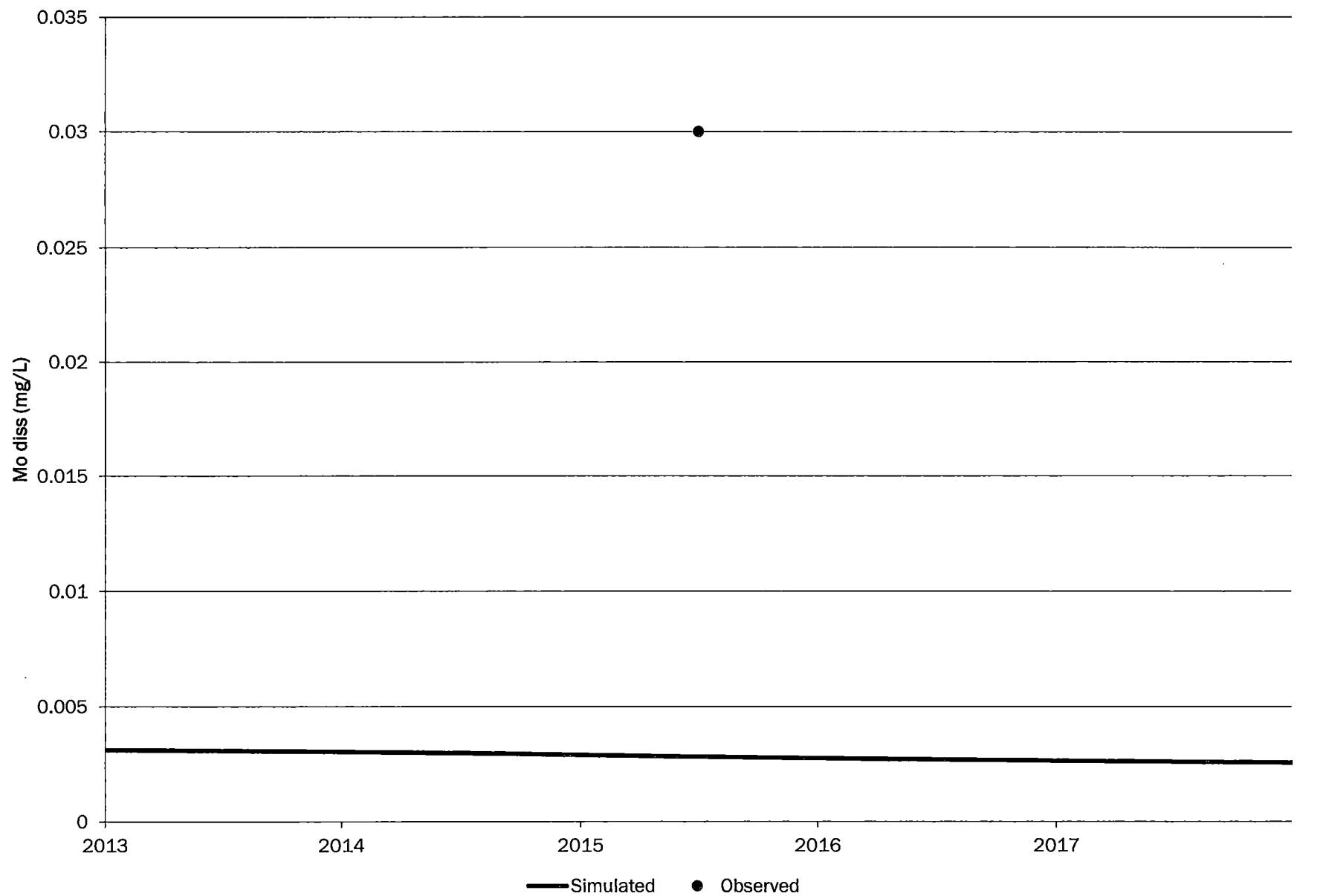
0634-AI



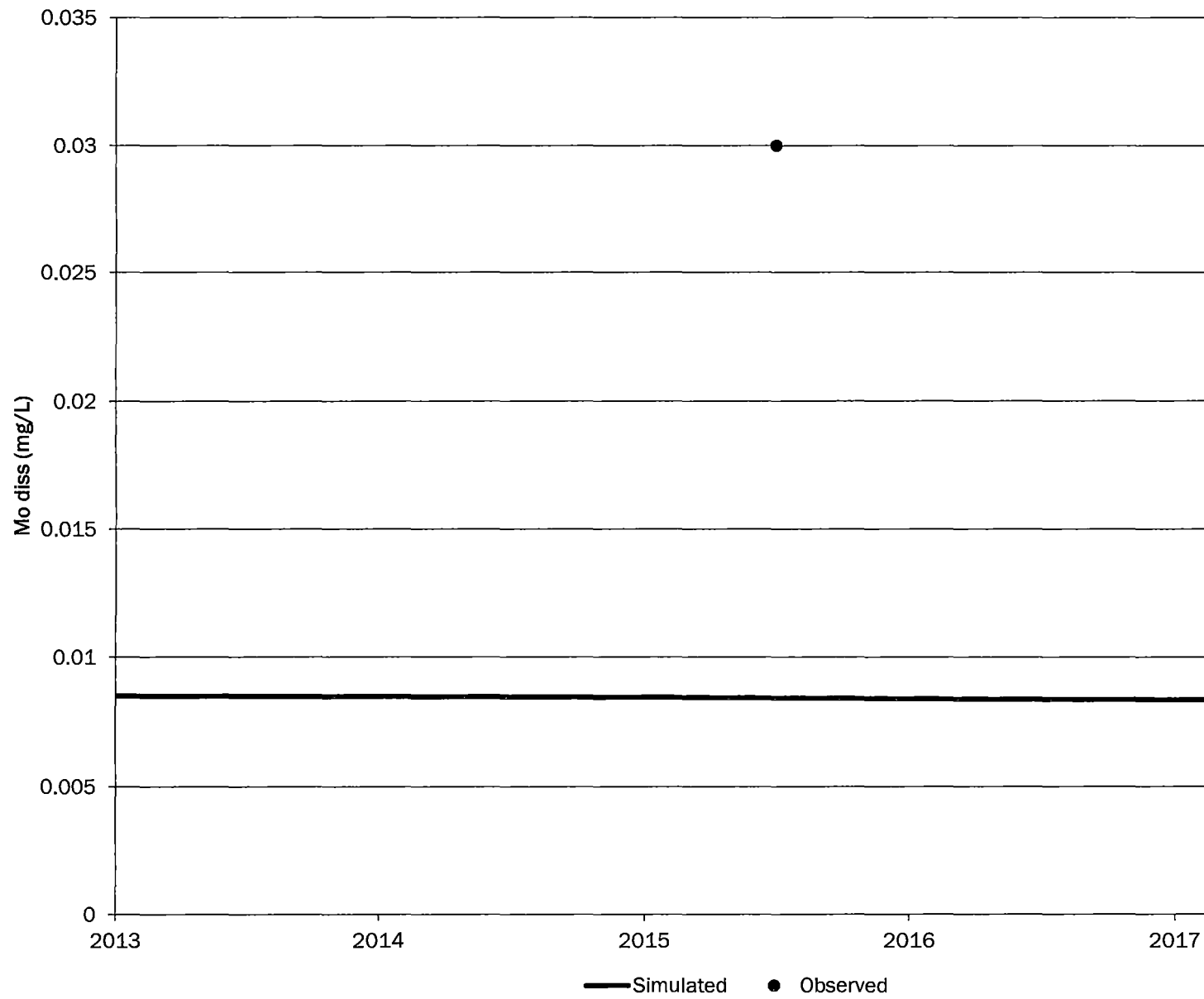
0637-AI



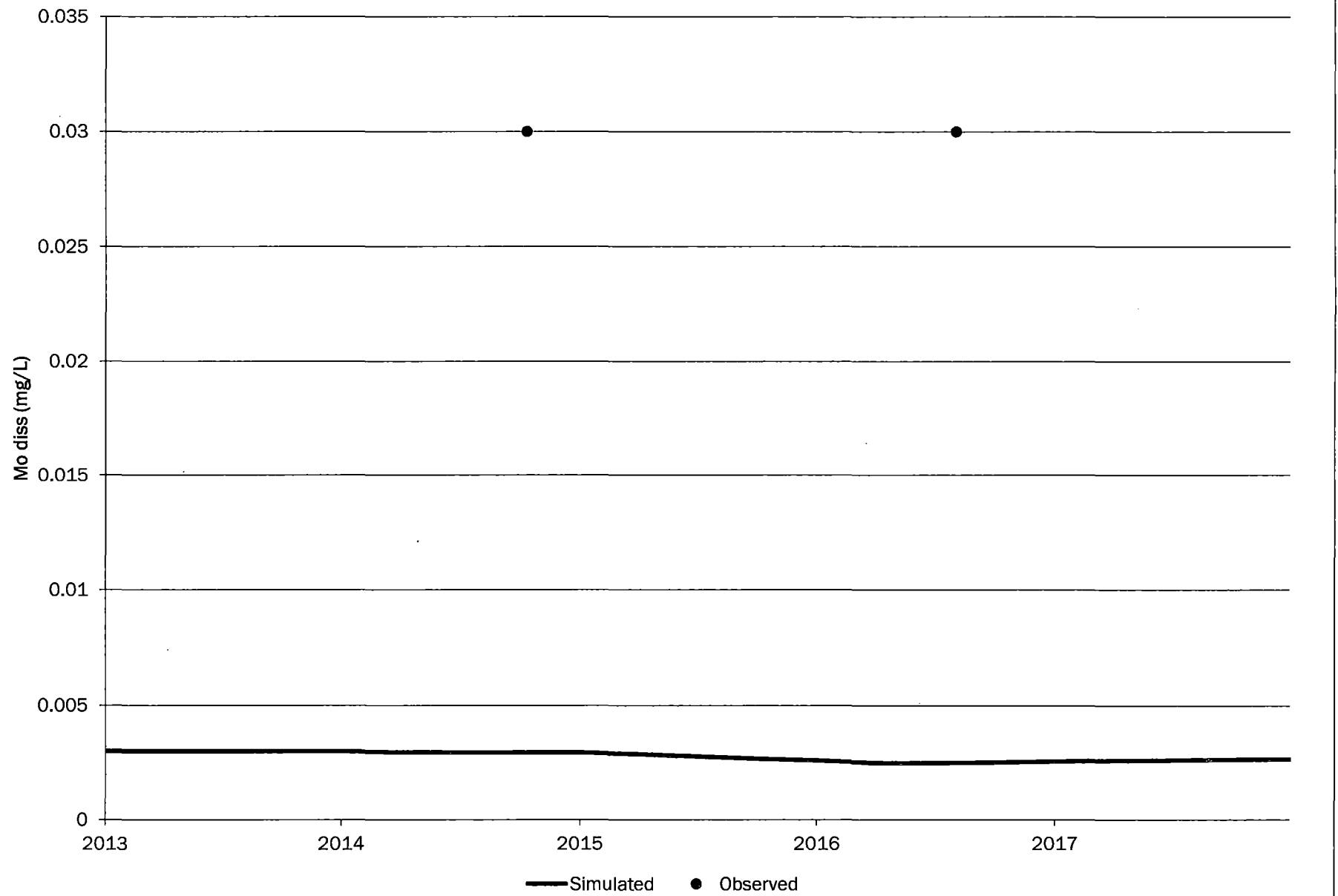
0641-AI



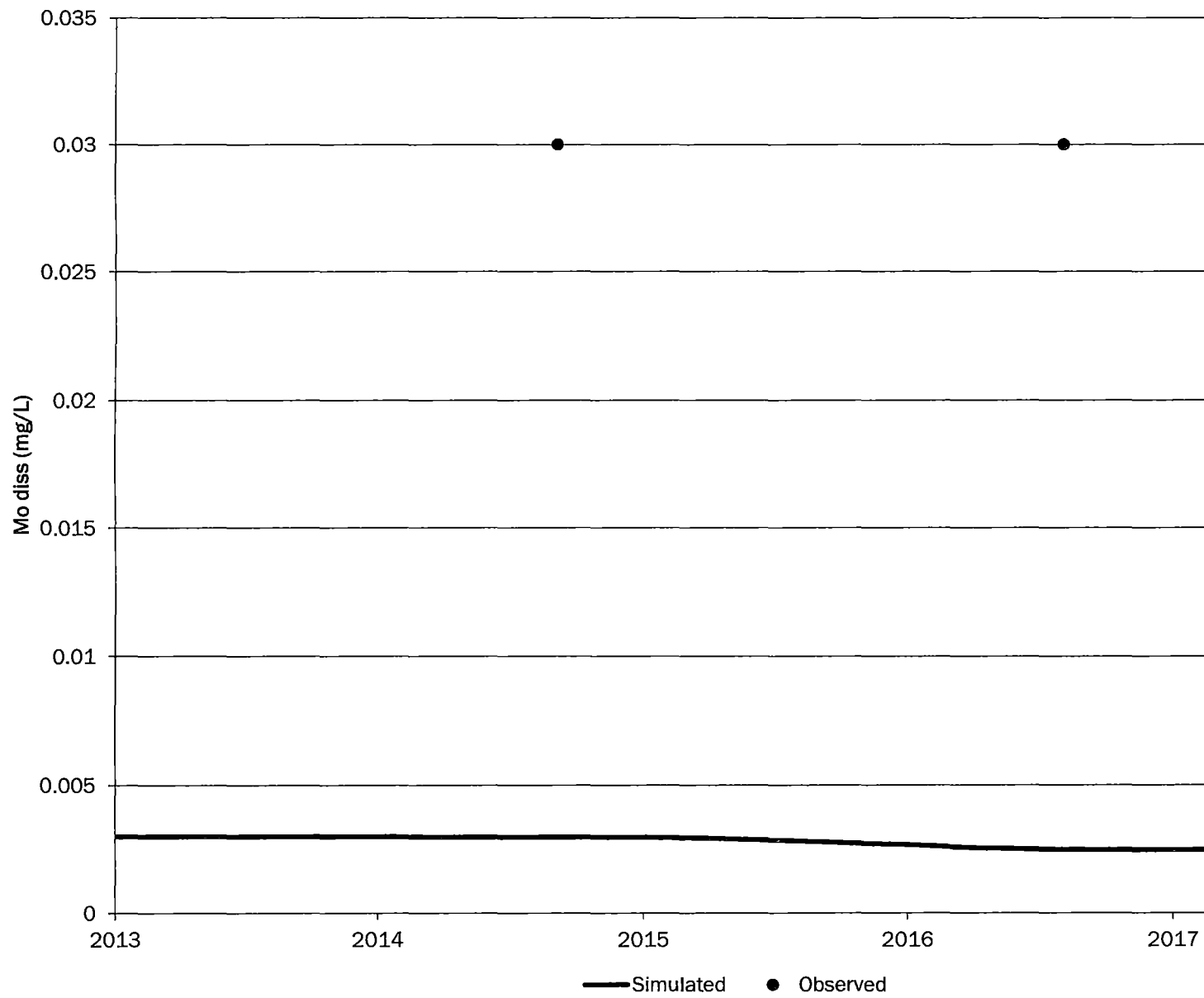
0642-AI



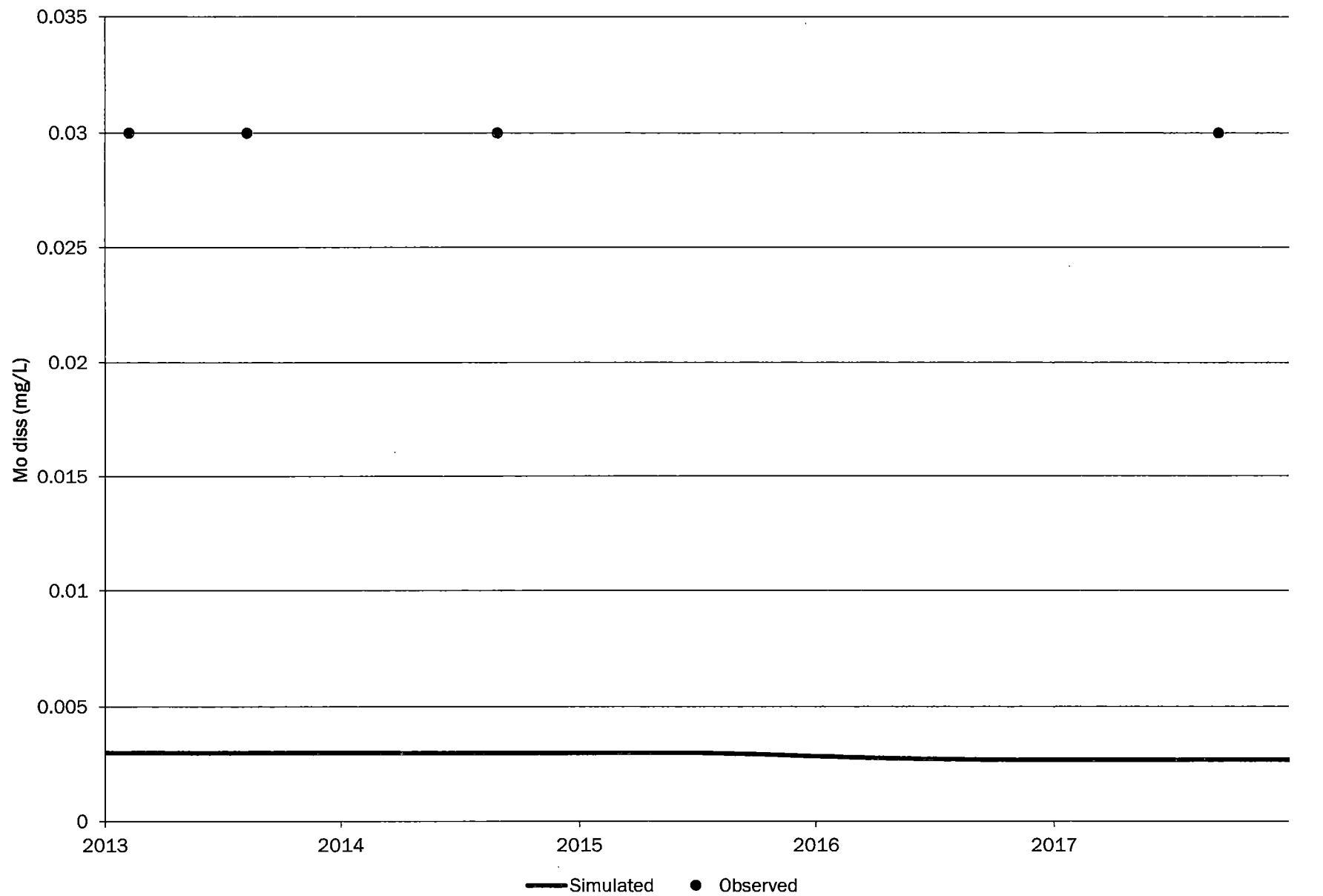
0644-AI



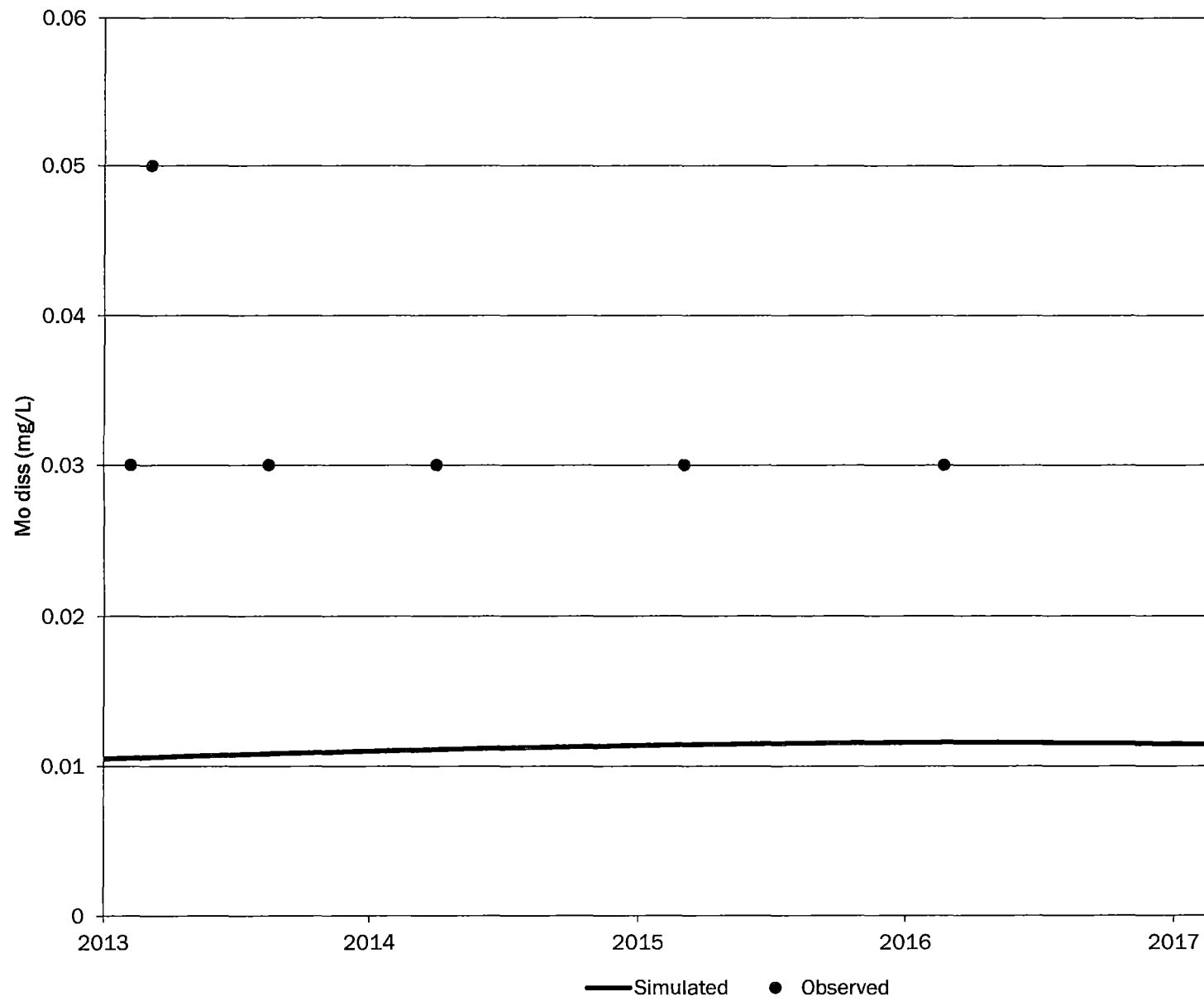
0646-AI



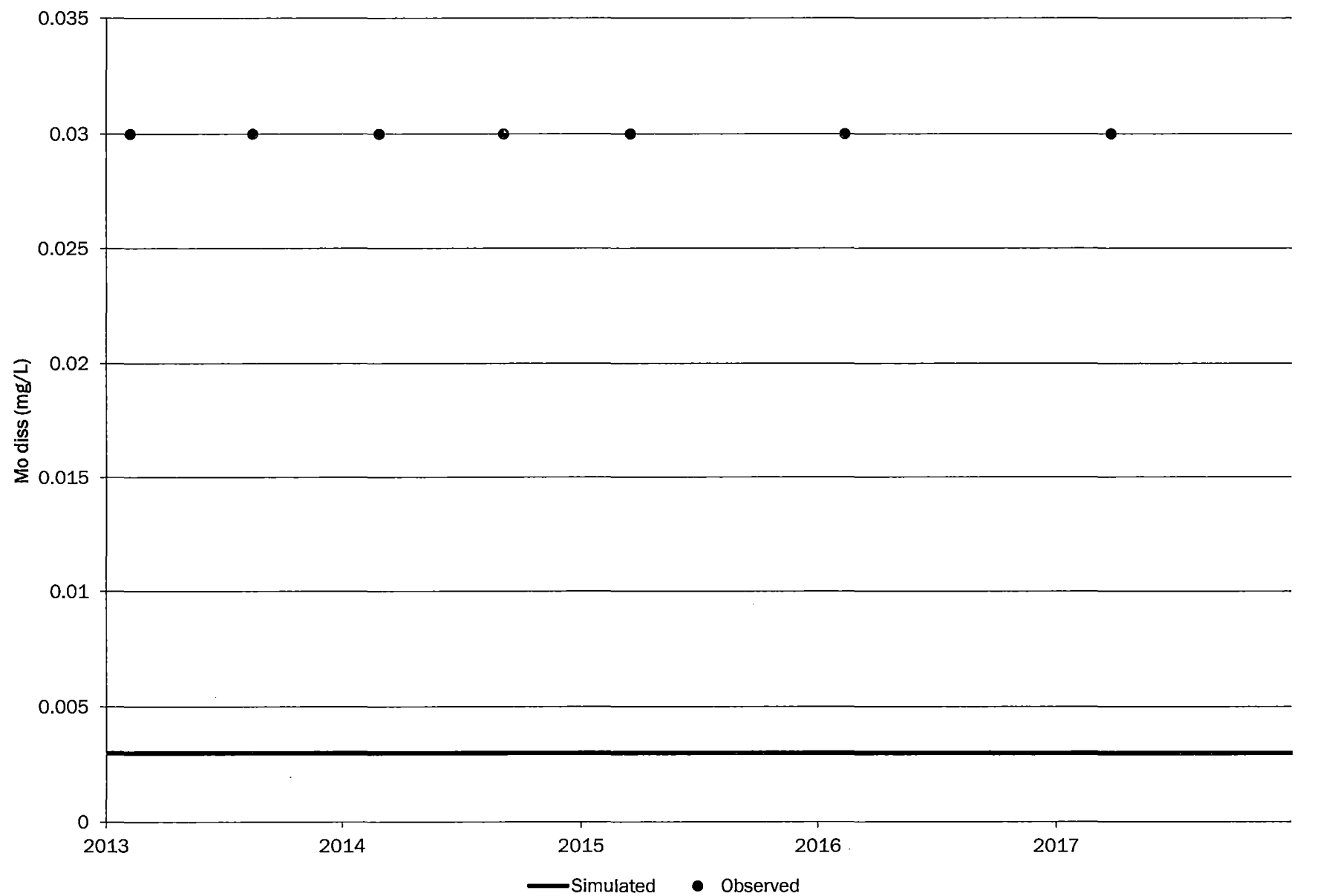
0647-AI



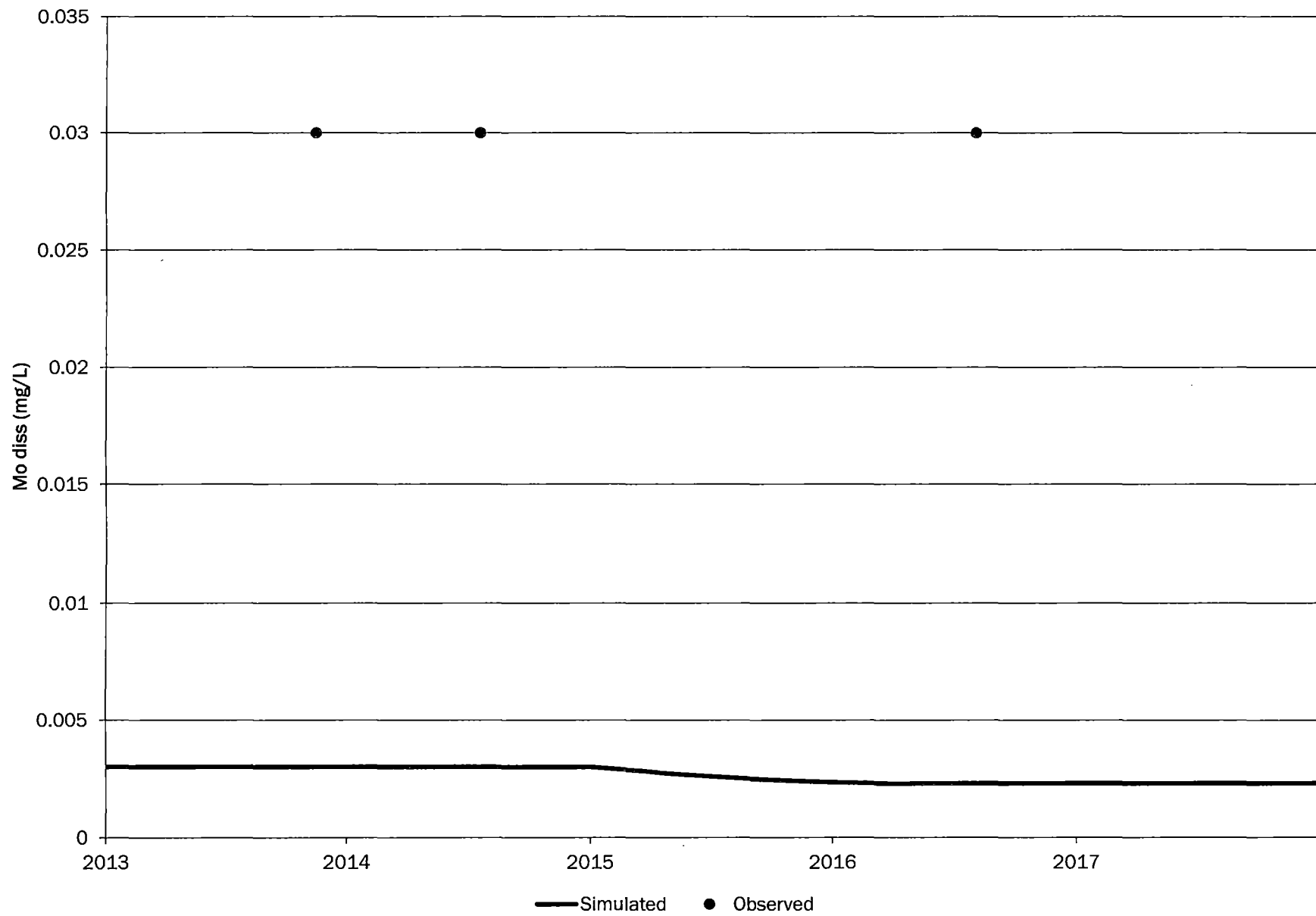
0649-AI



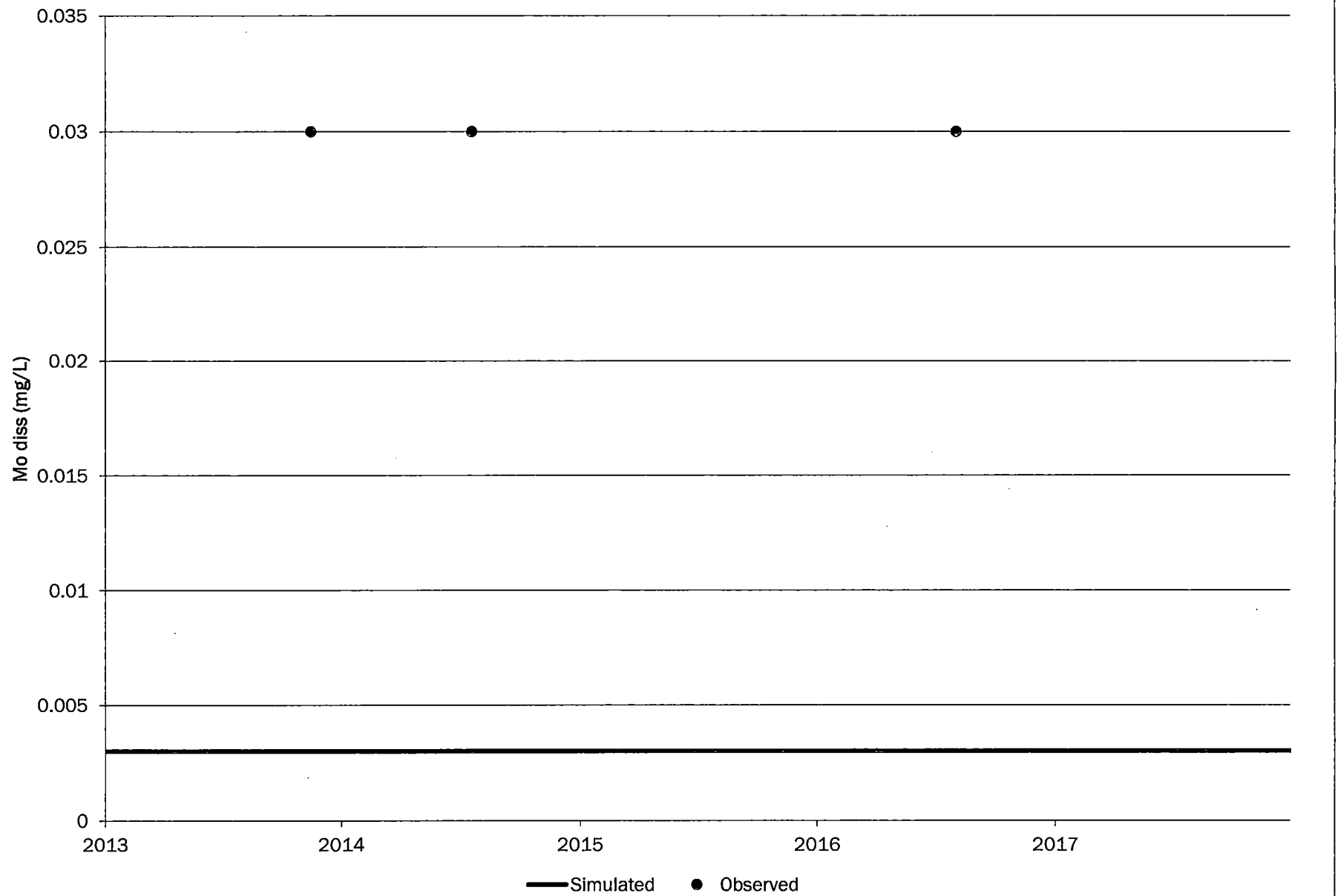
0650-AI



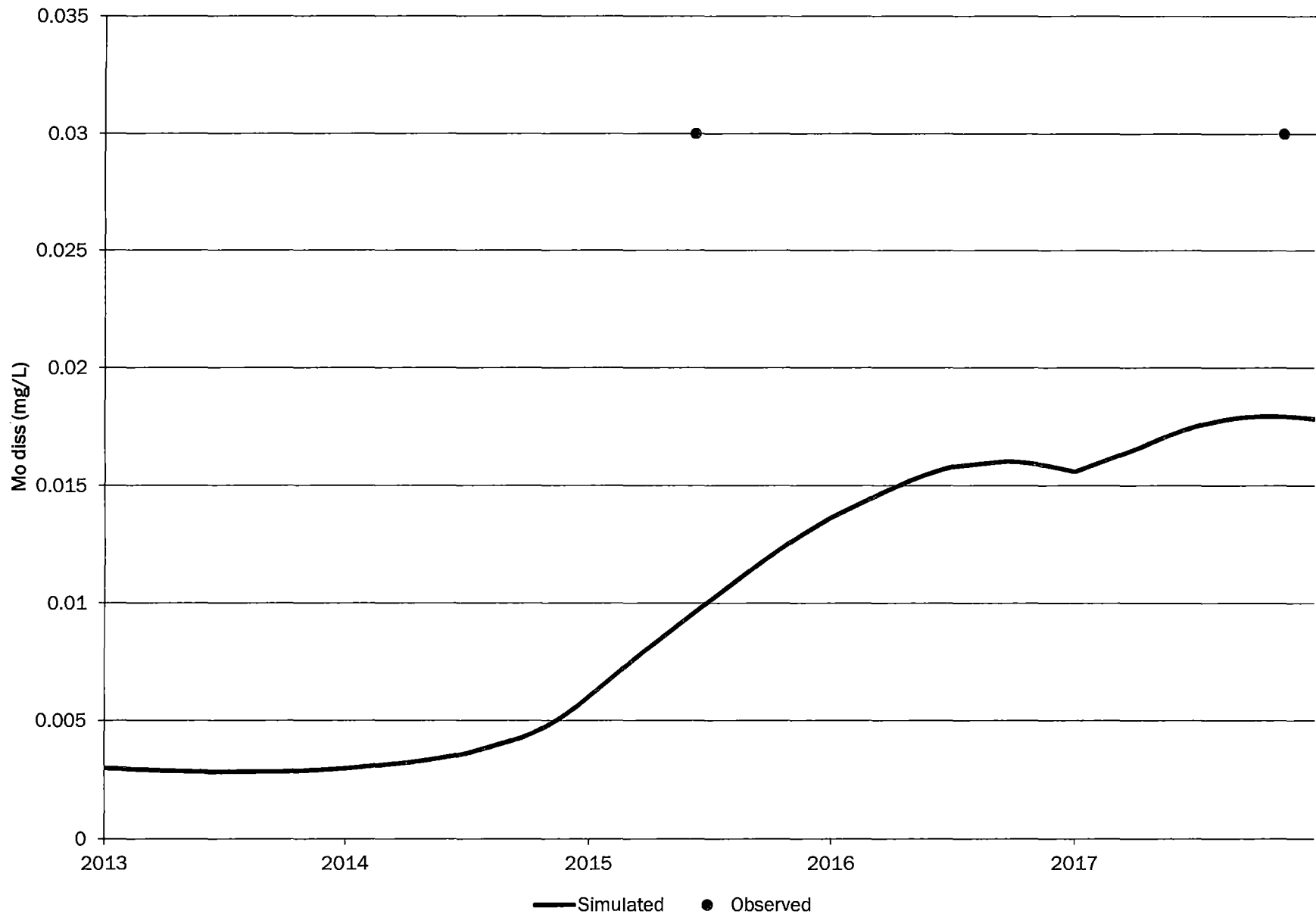
0653-AI



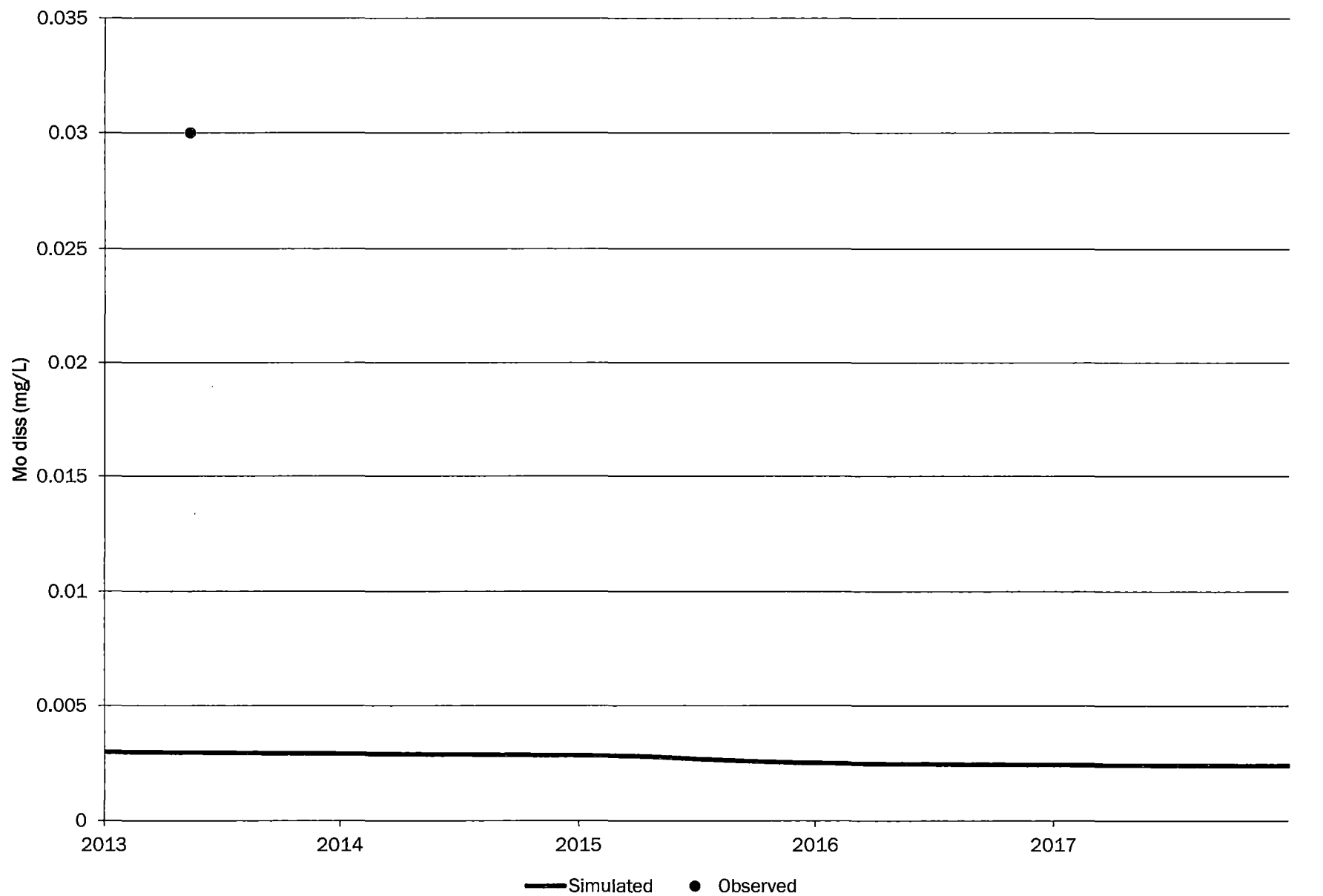
0653-LC



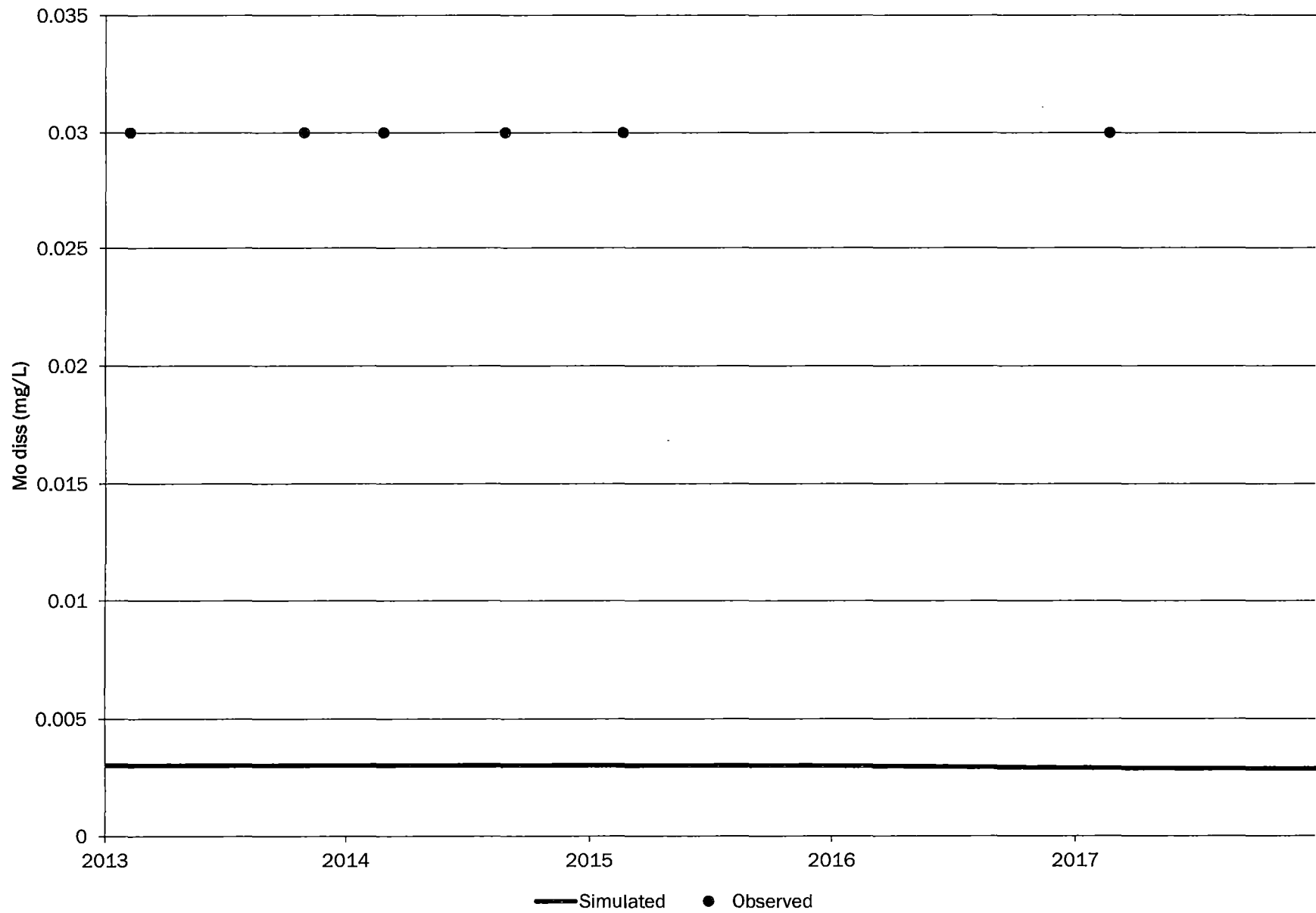
0654-AI



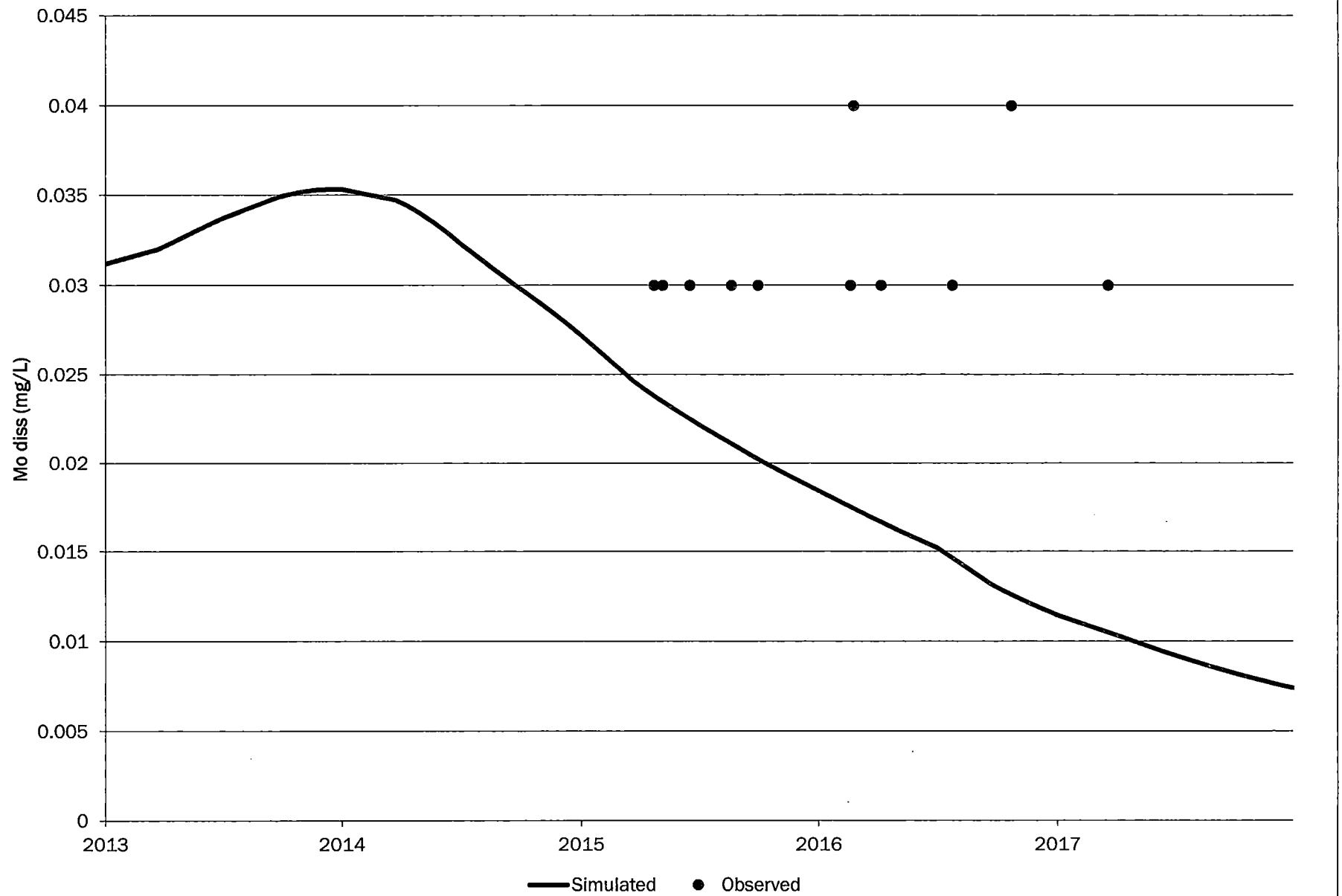
0657-AI



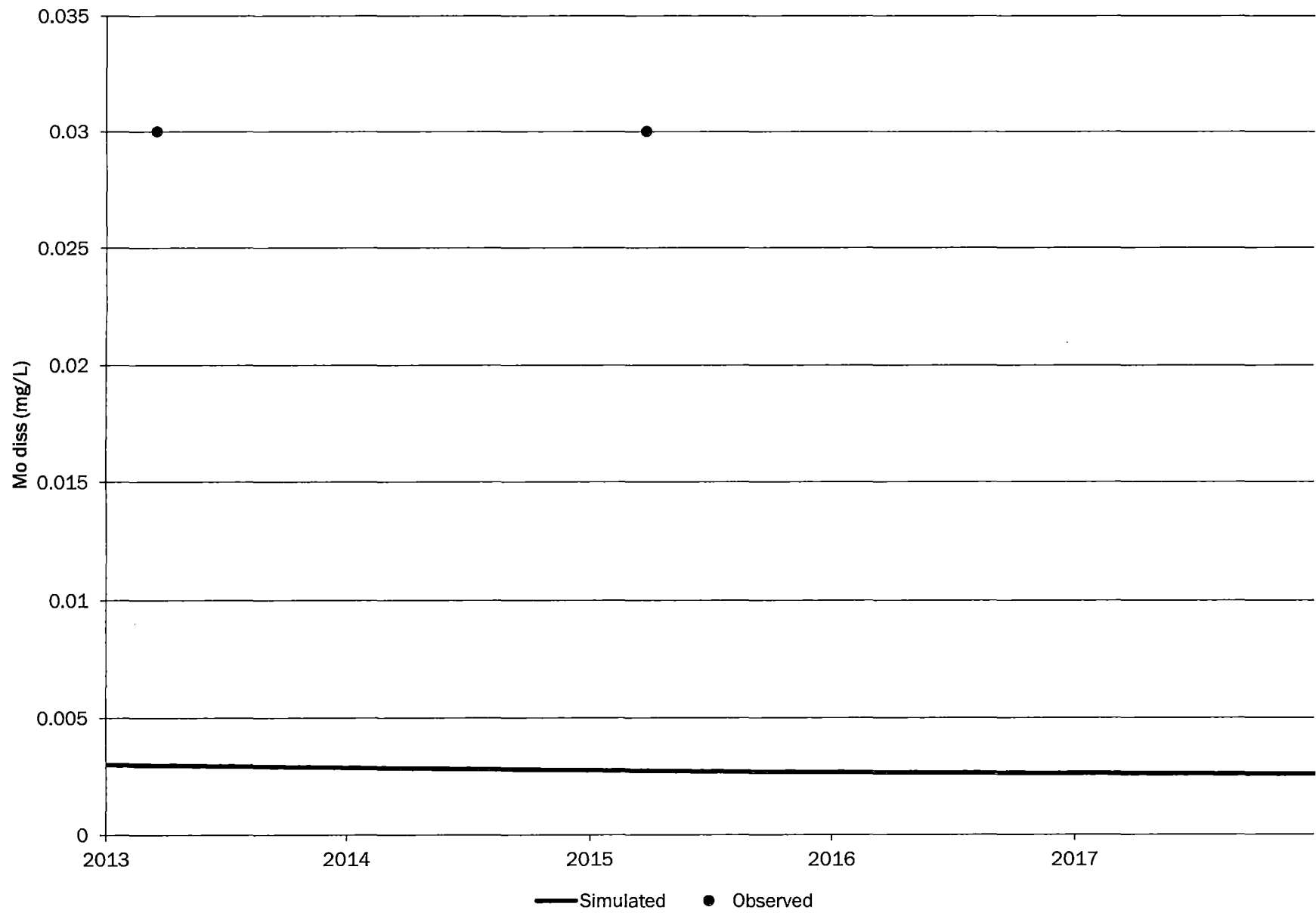
0658-AI



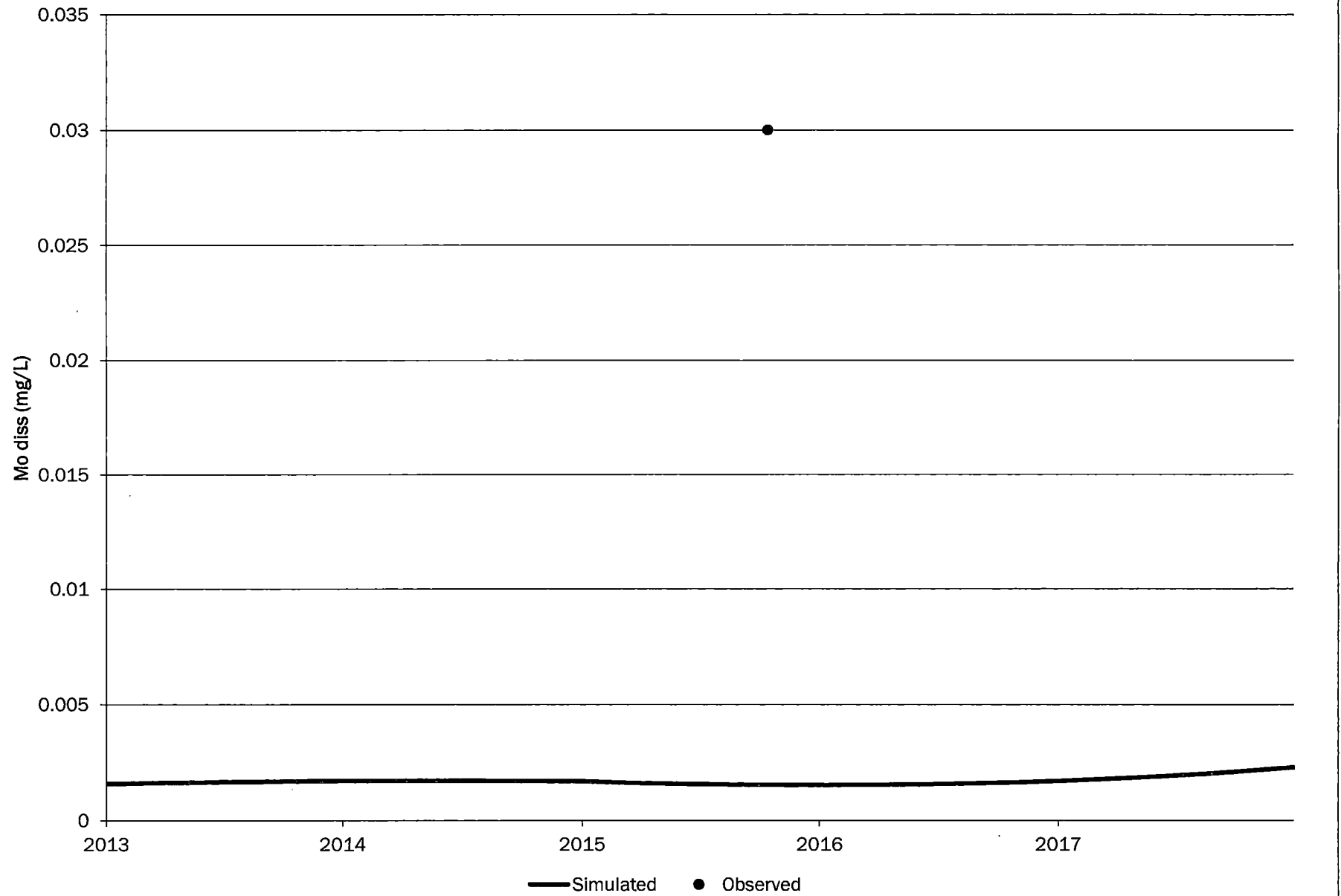
0659-AI



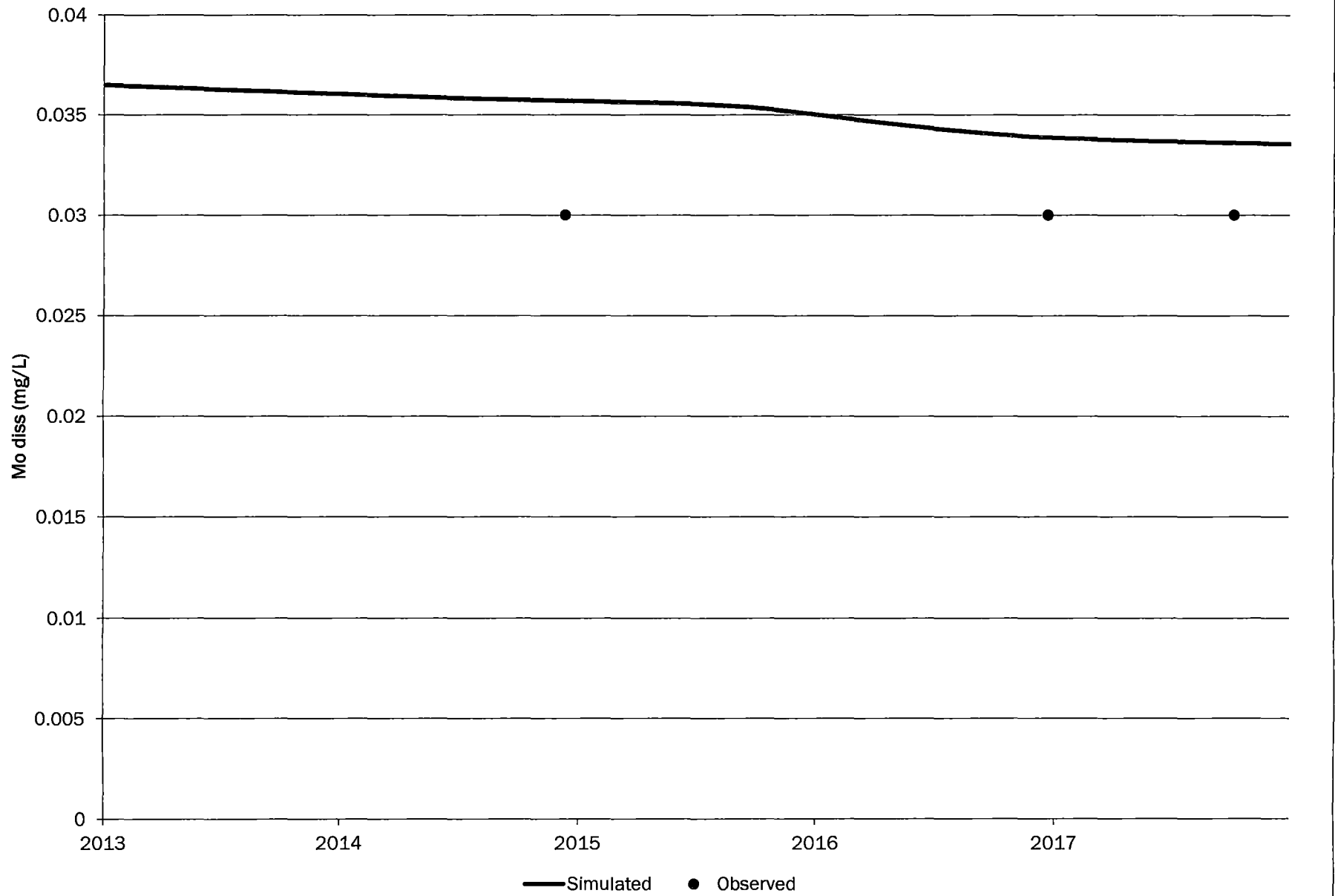
0681-AI



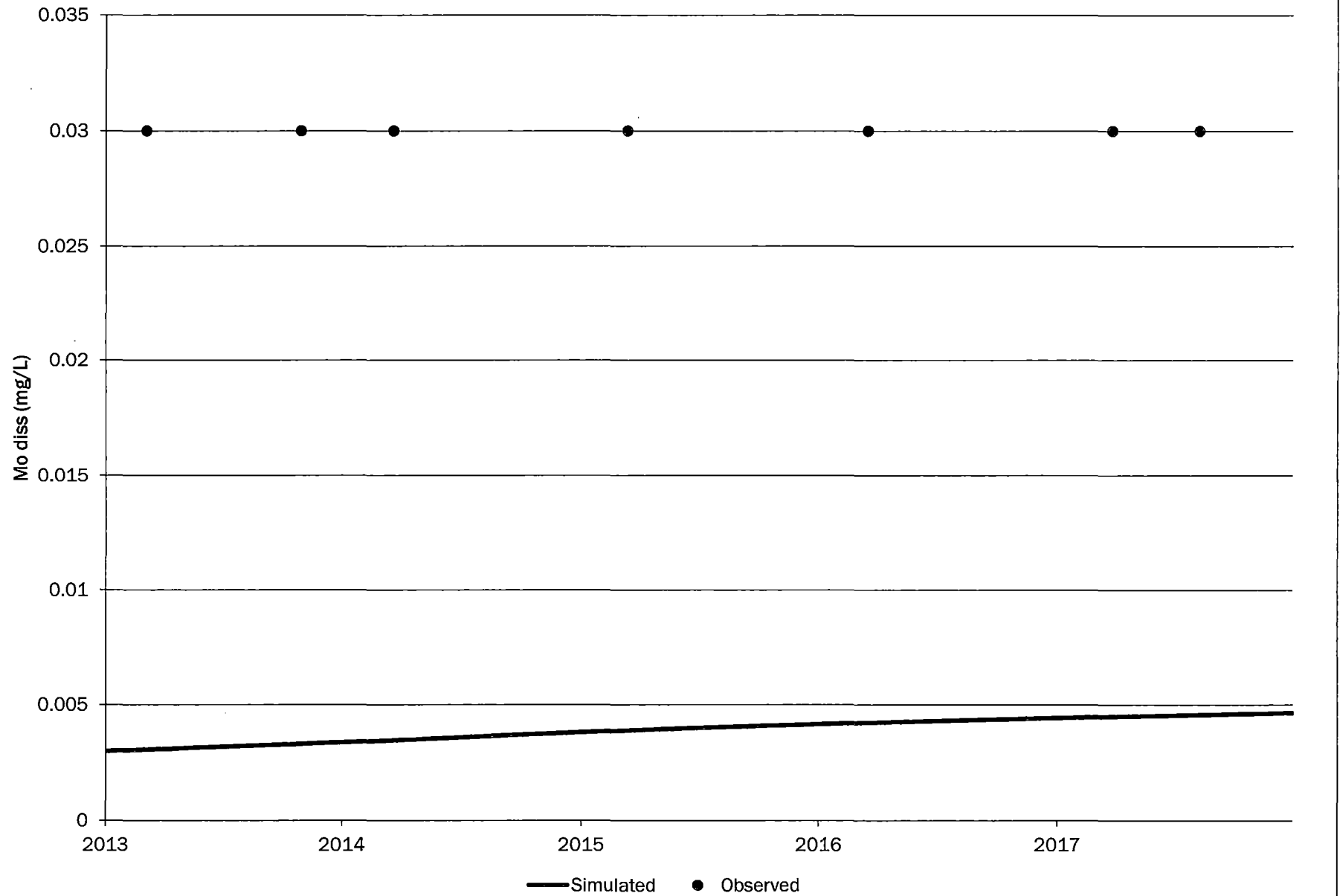
0684-AI



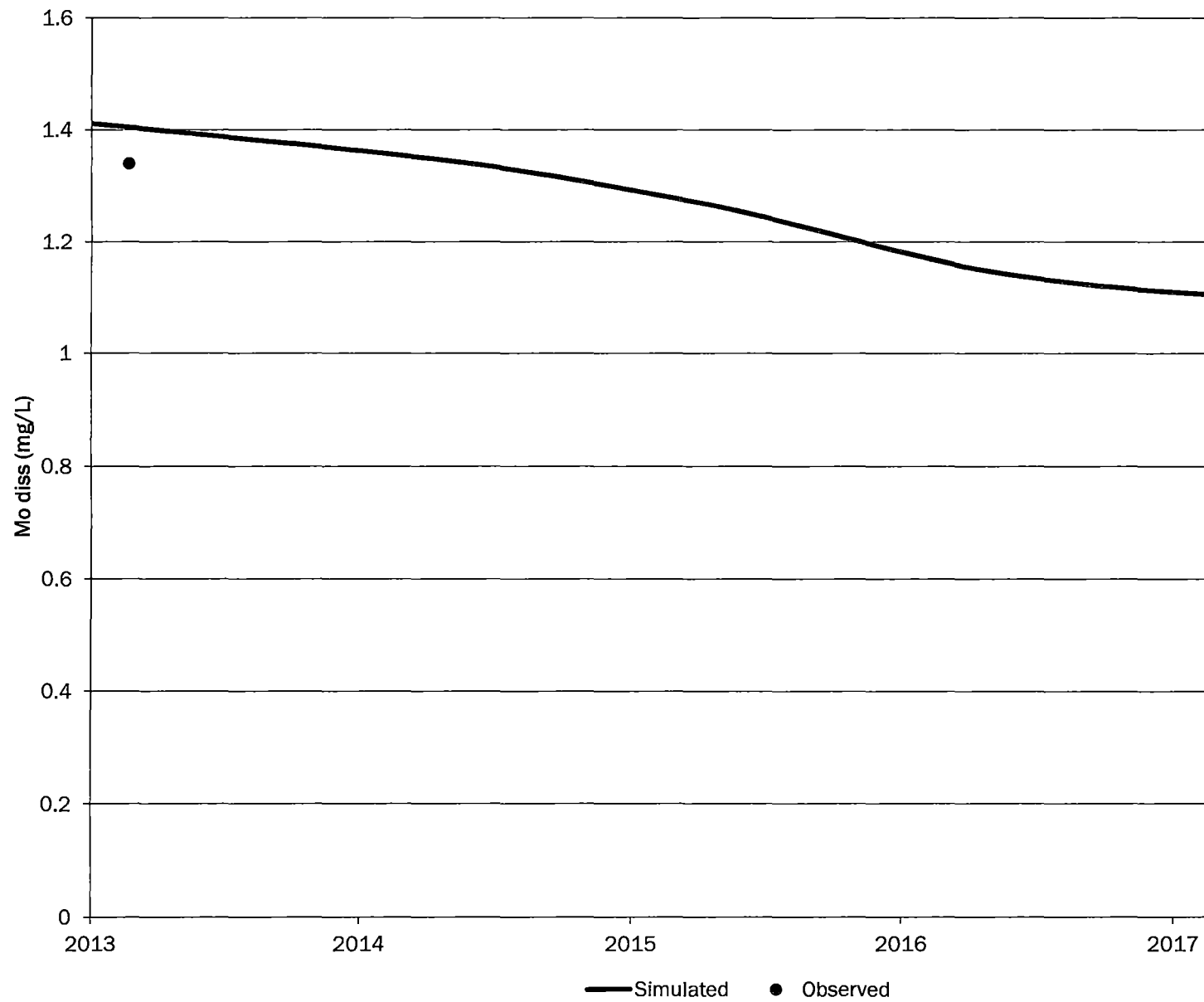
0686-AI



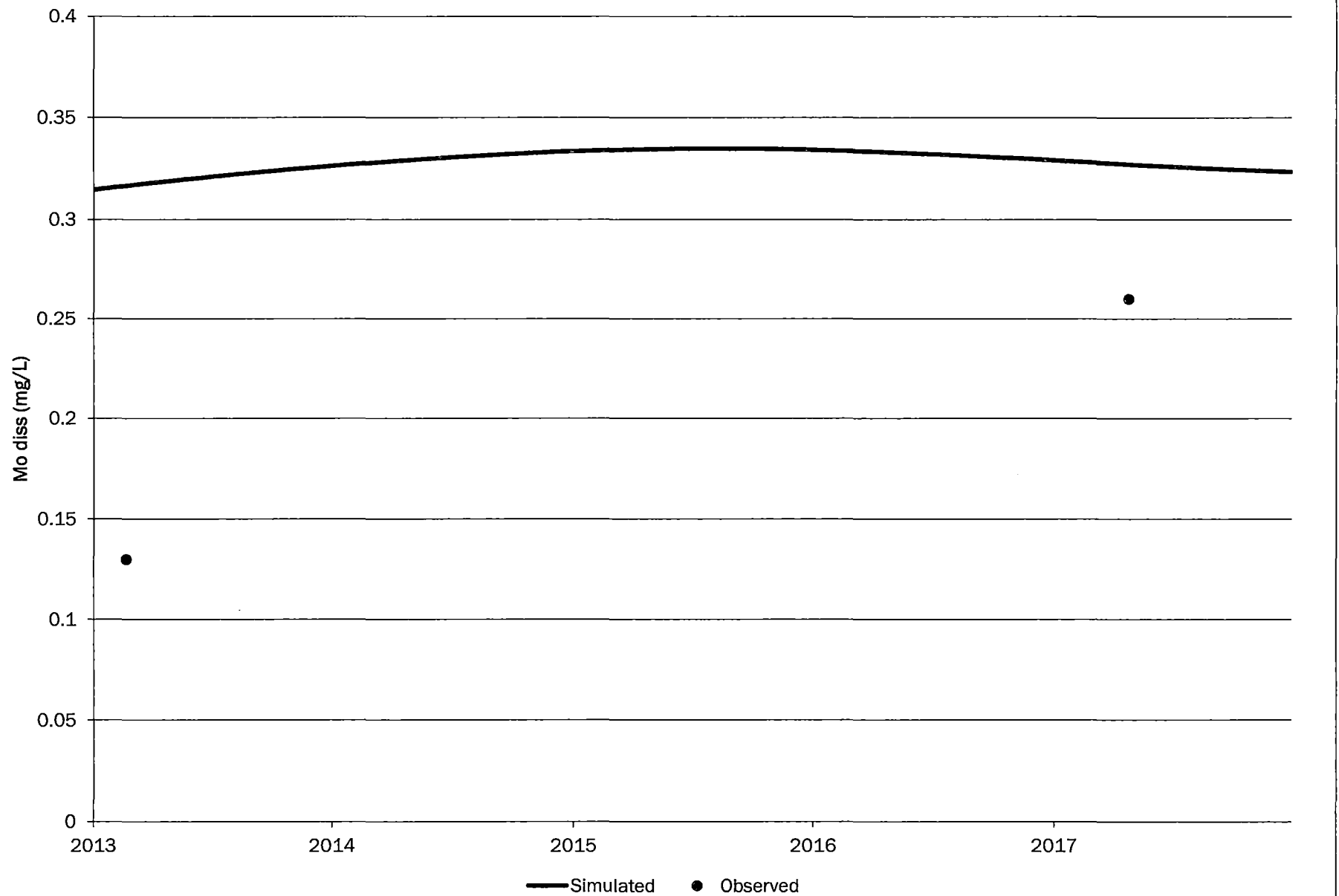
0688-AI



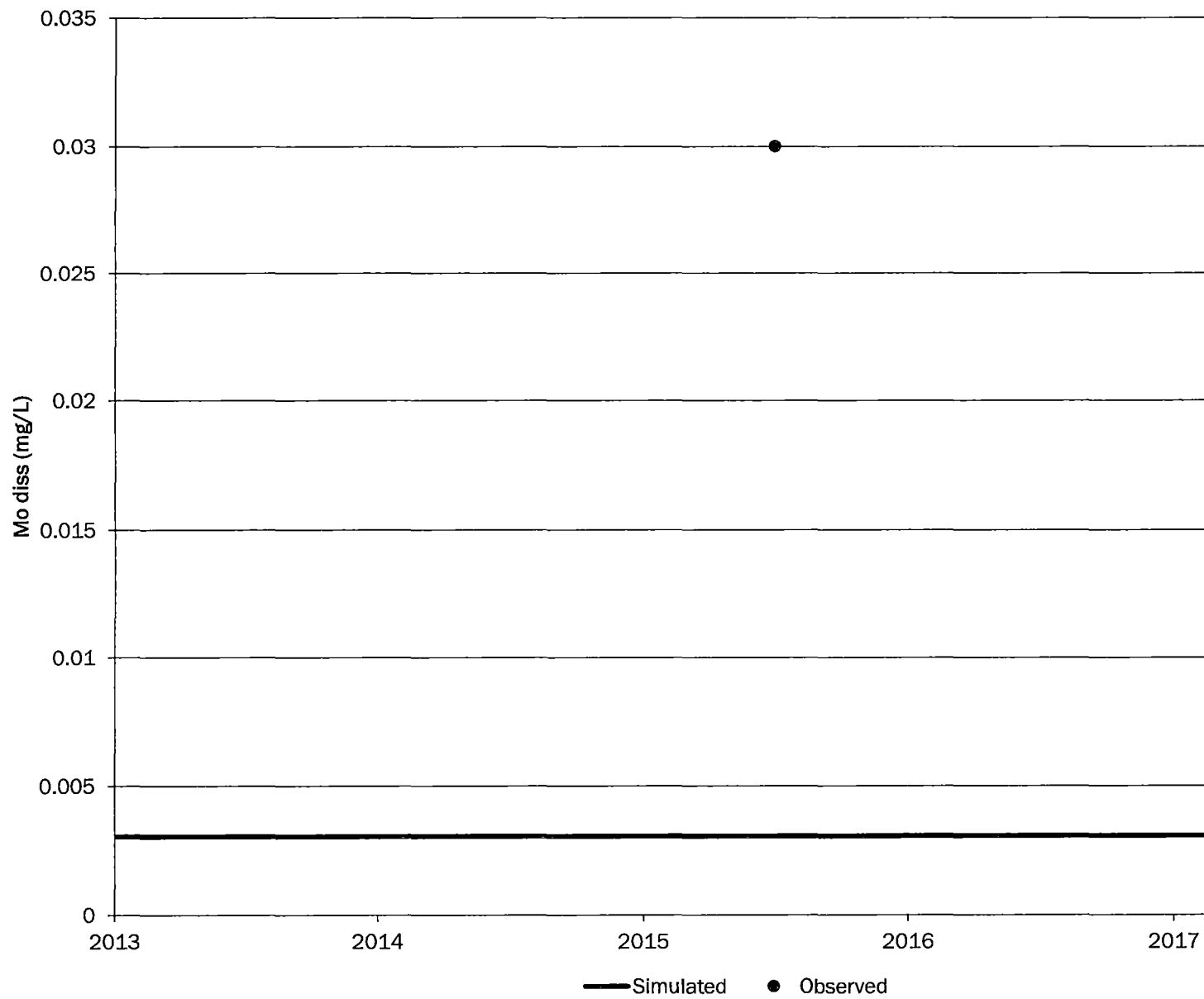
0690-AI



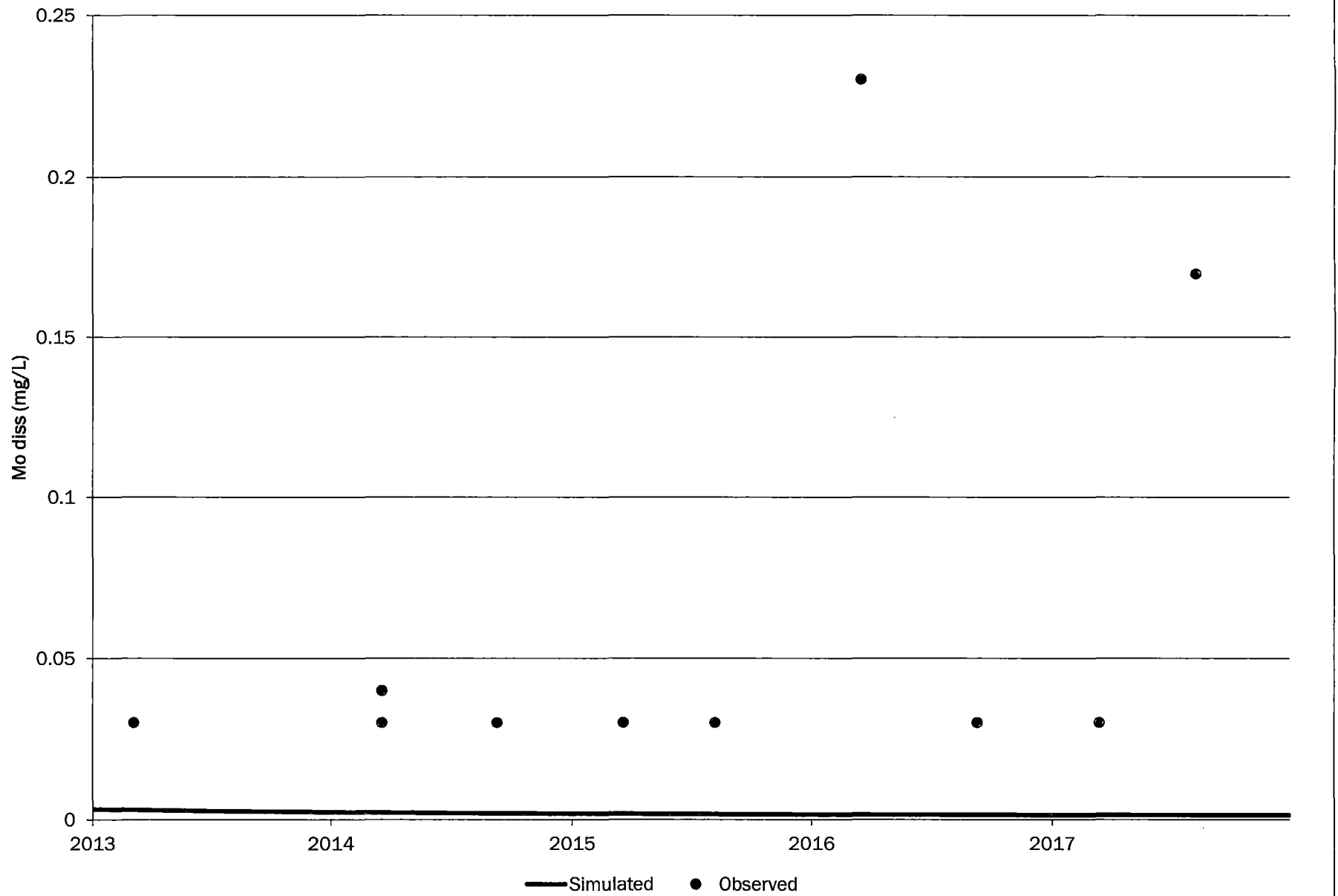
0691-AI



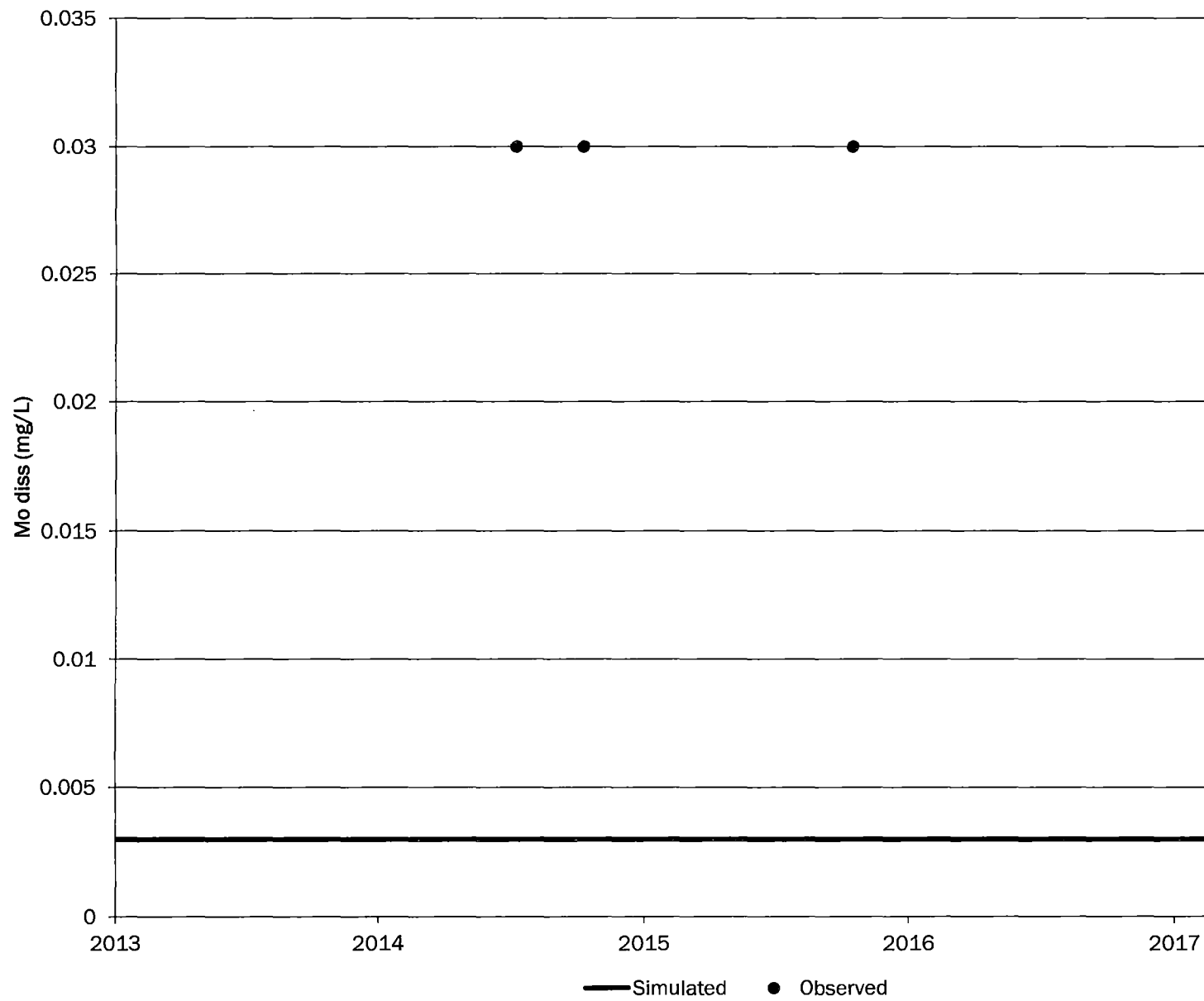
0692-AI



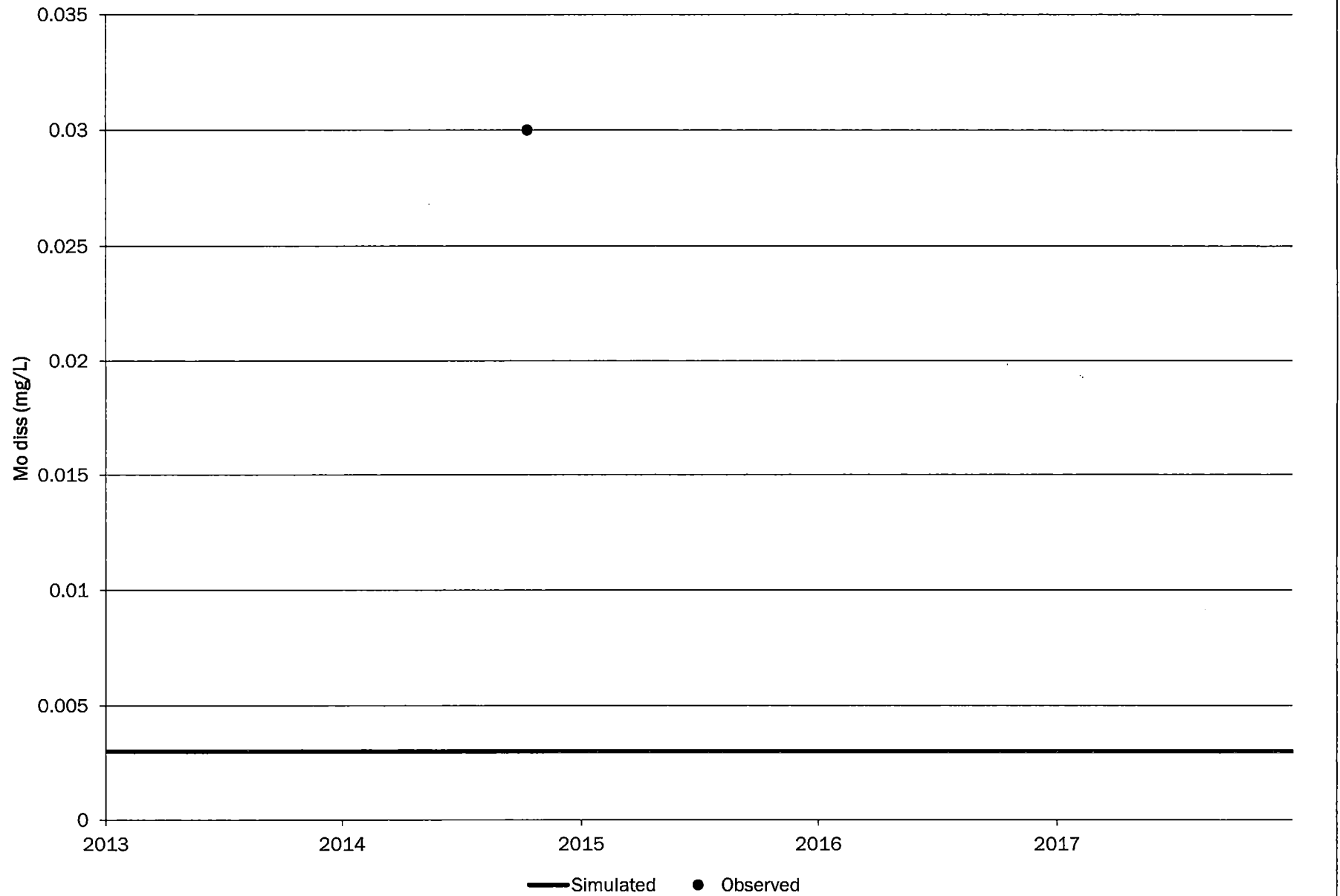
0802-AI



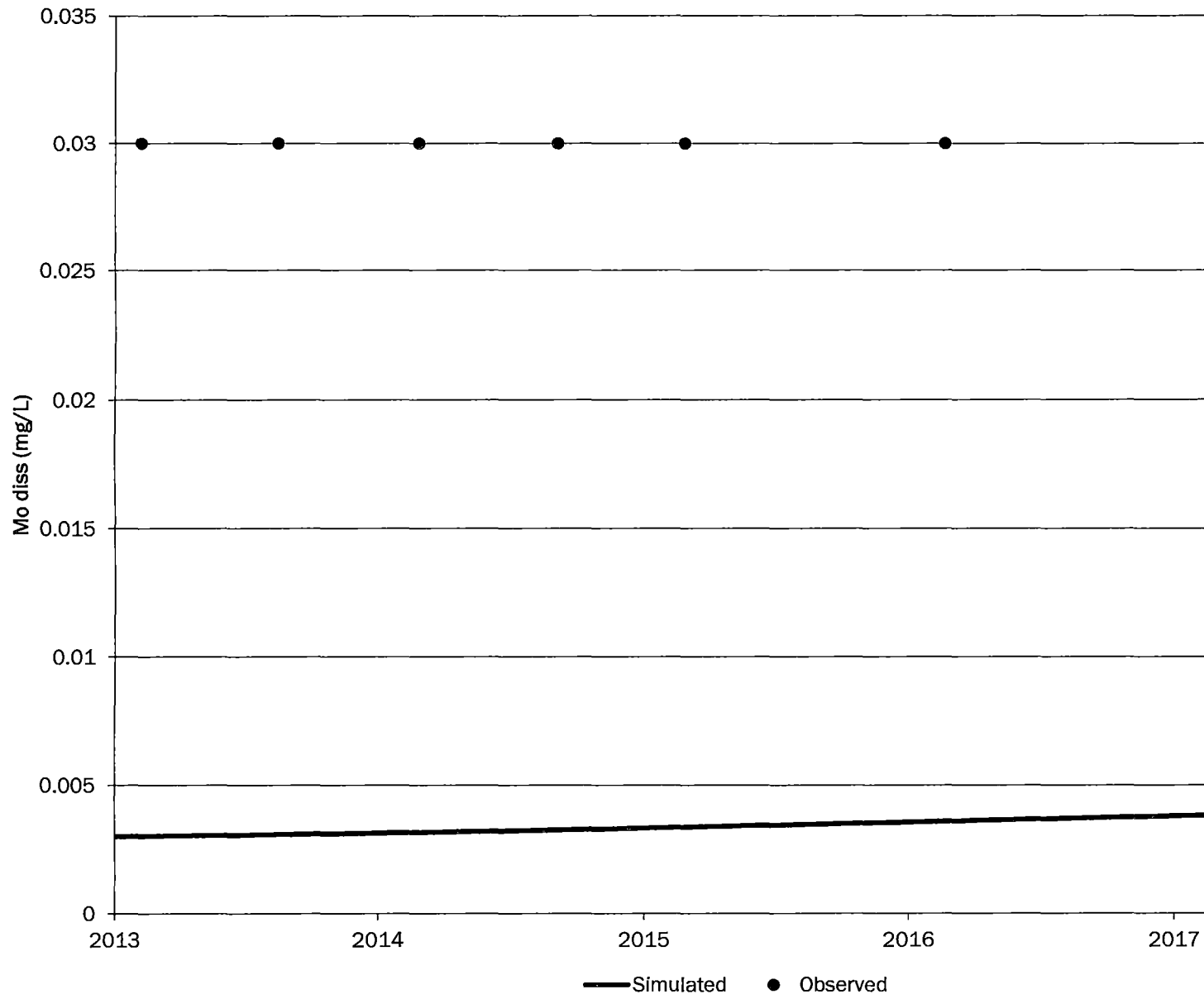
0806R-SA



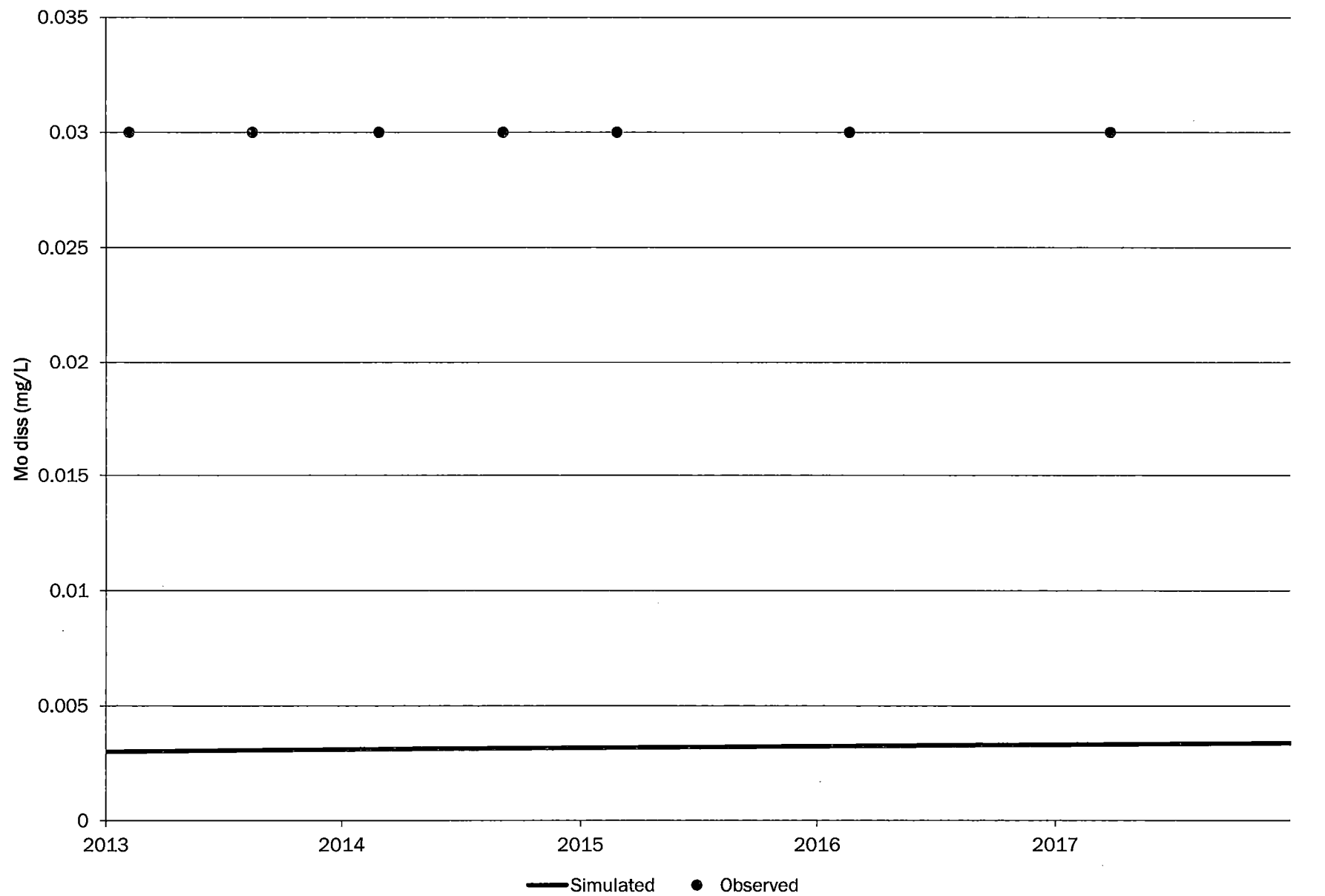
0806-SA



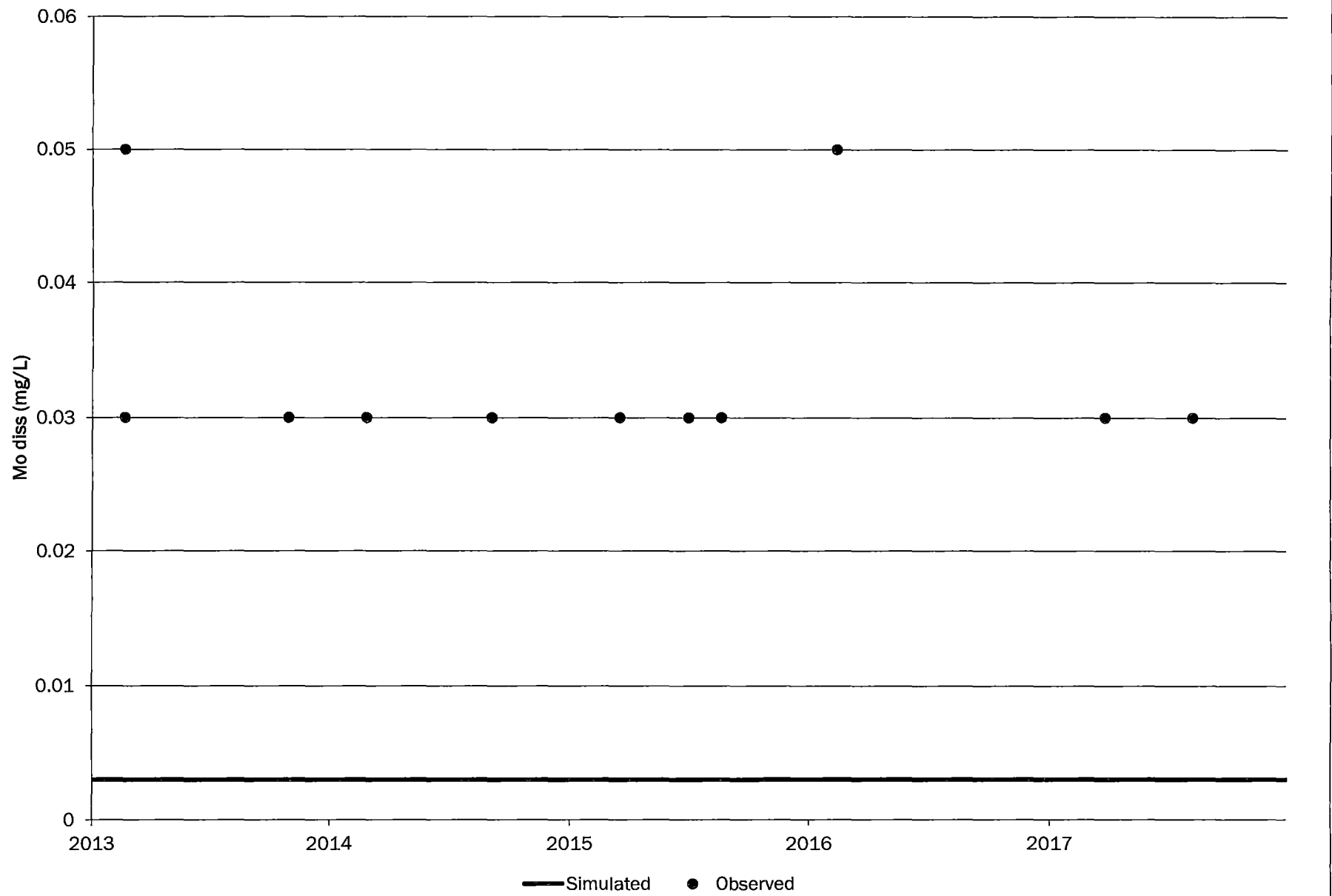
0844-AI



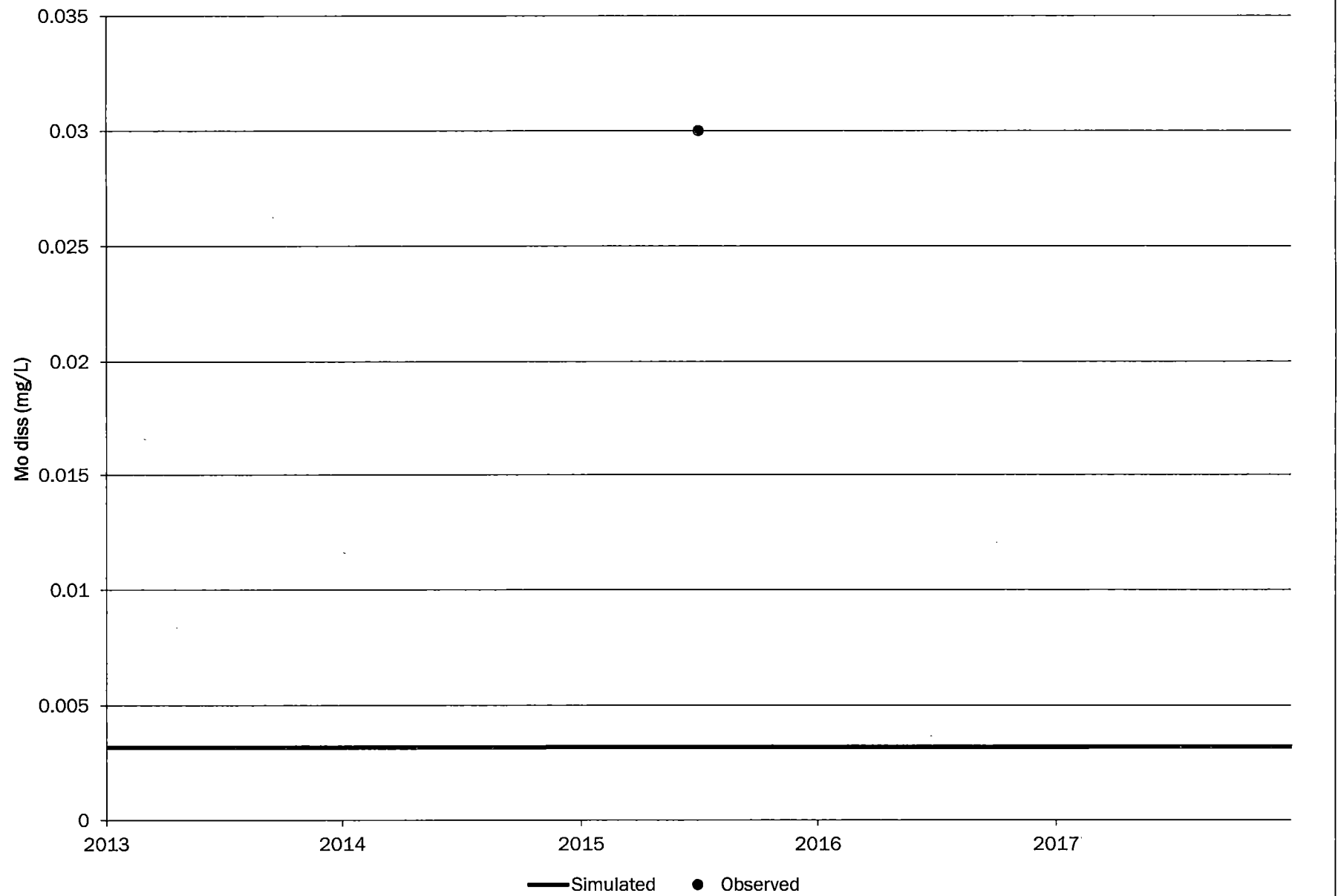
0845-AI



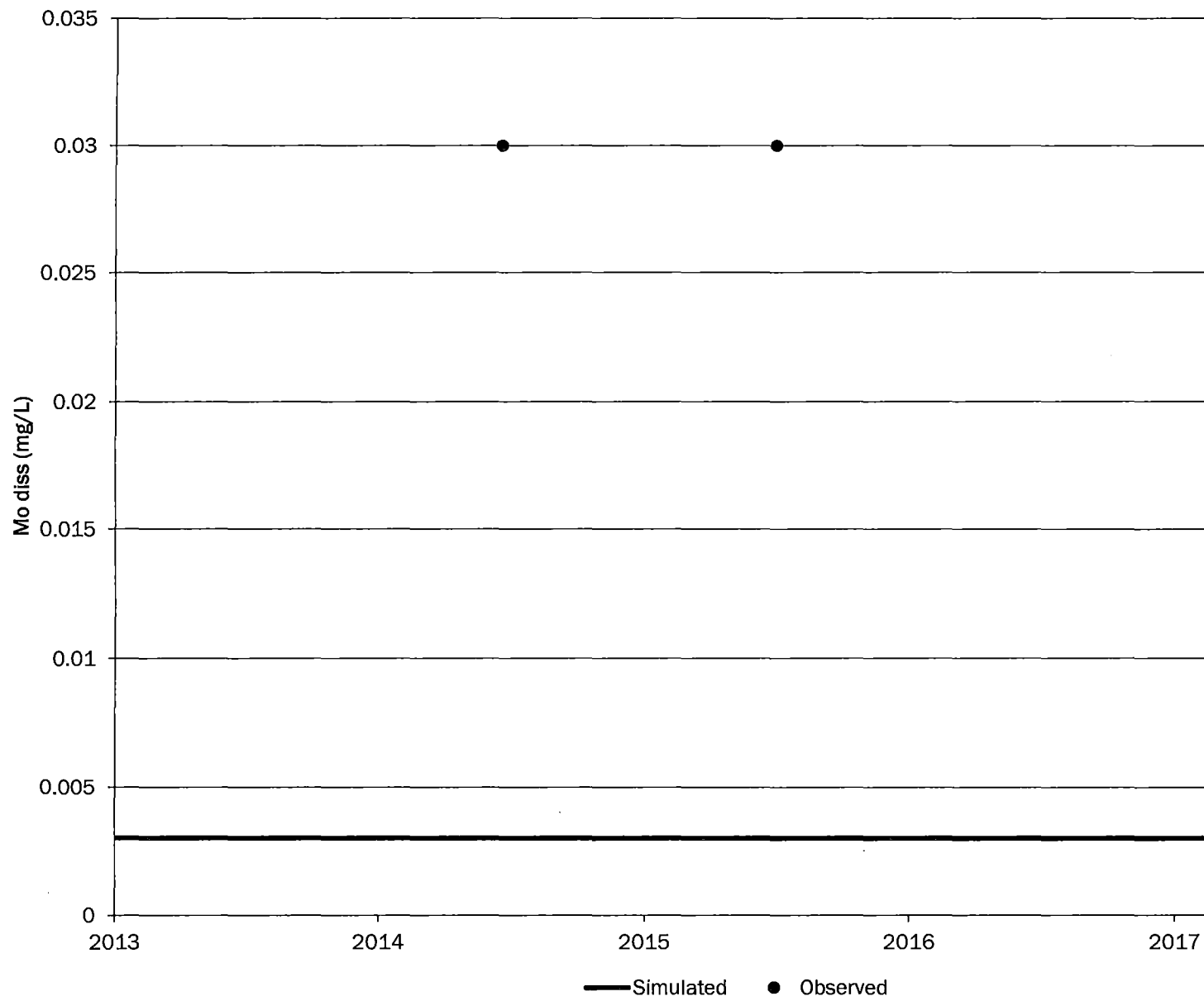
0846-AI



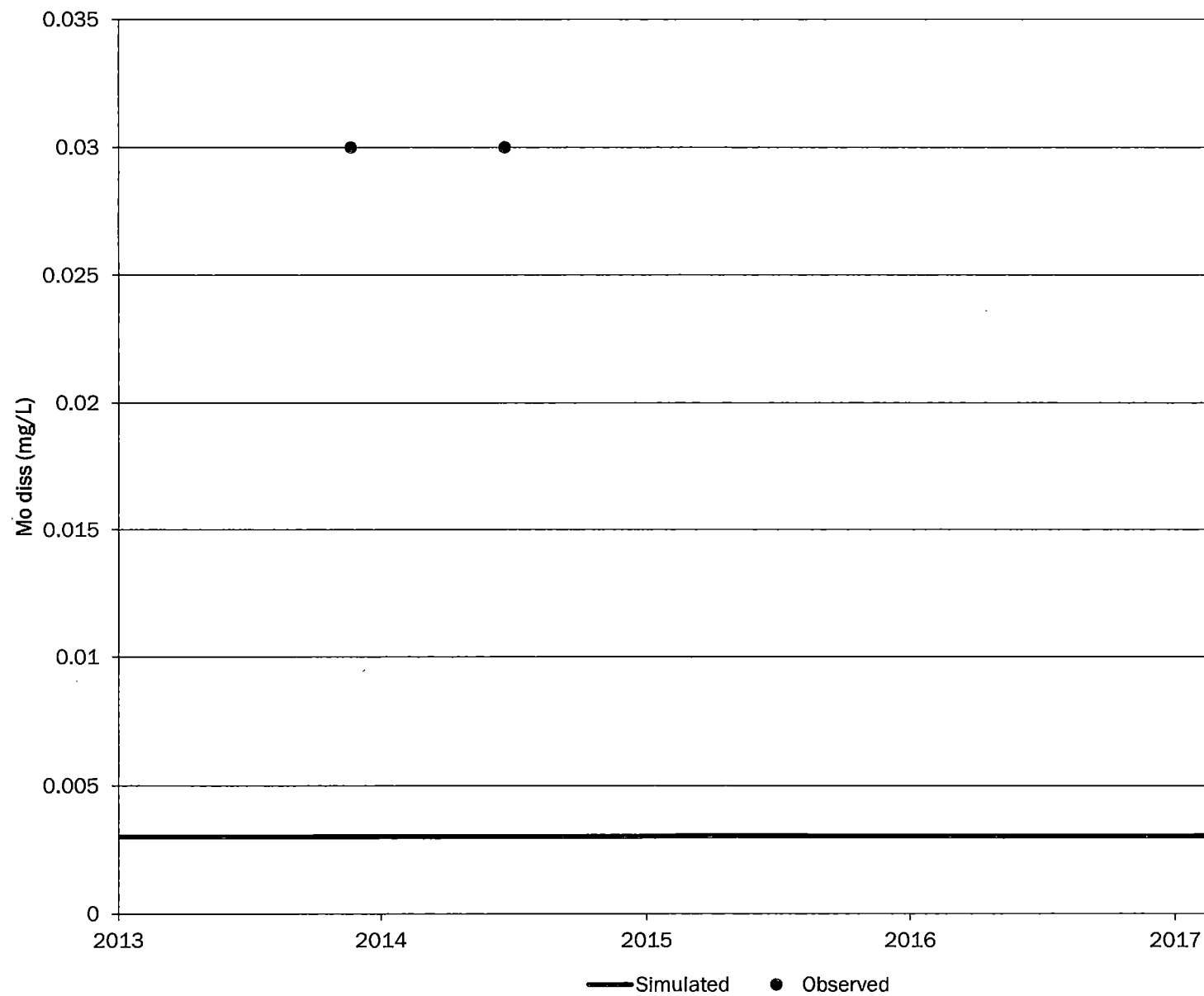
0852-AI



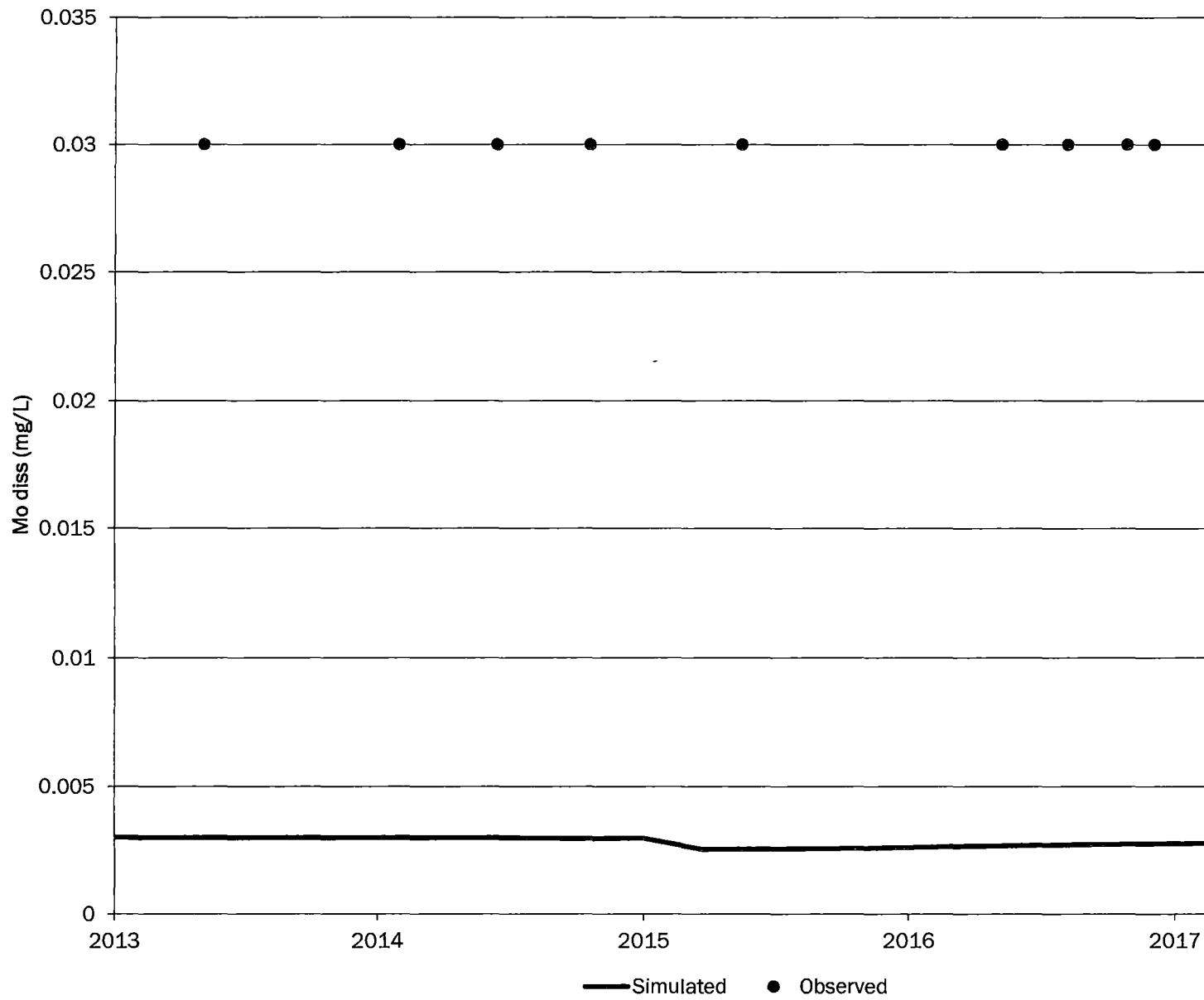
0853-LC



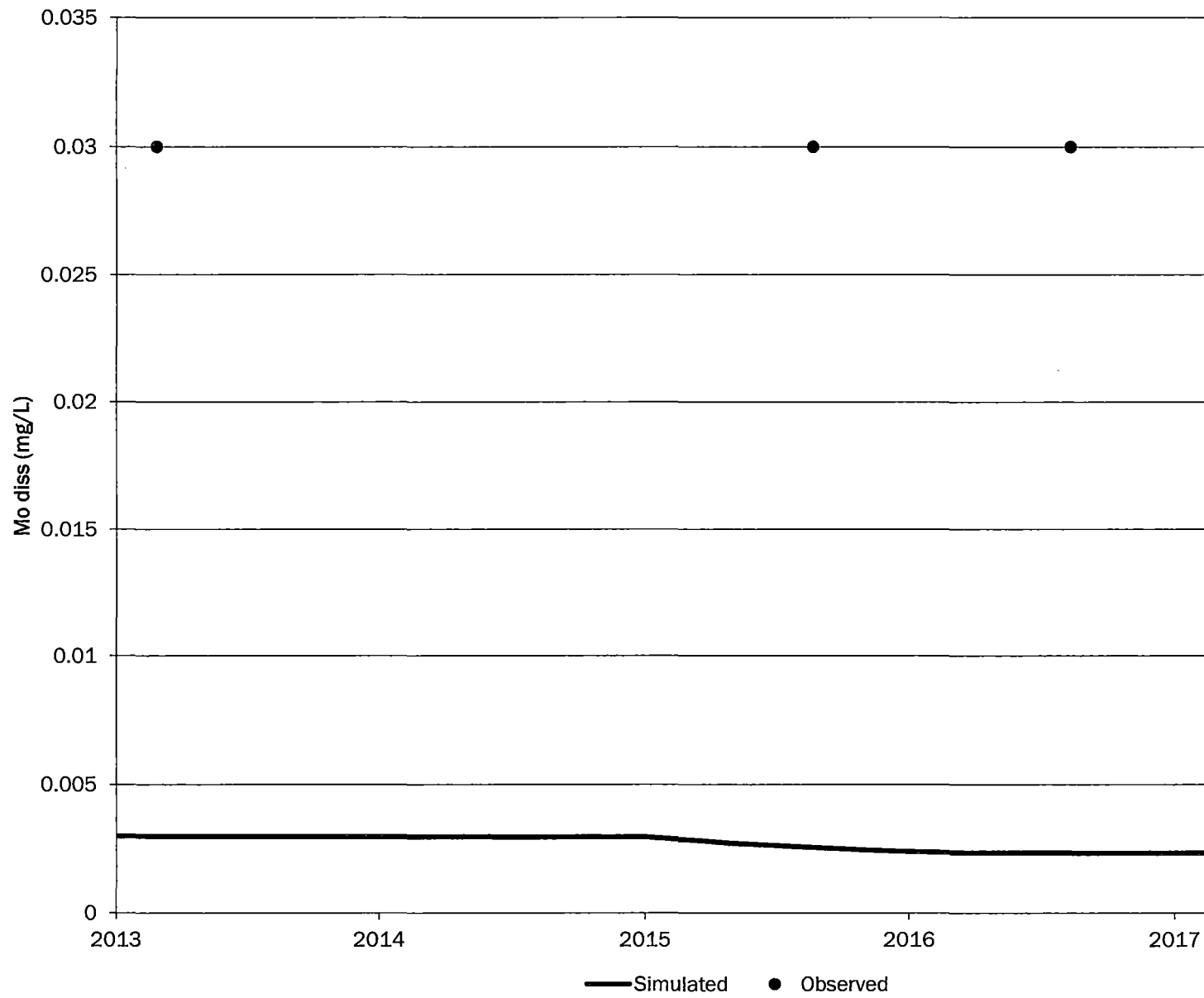
0859-MC



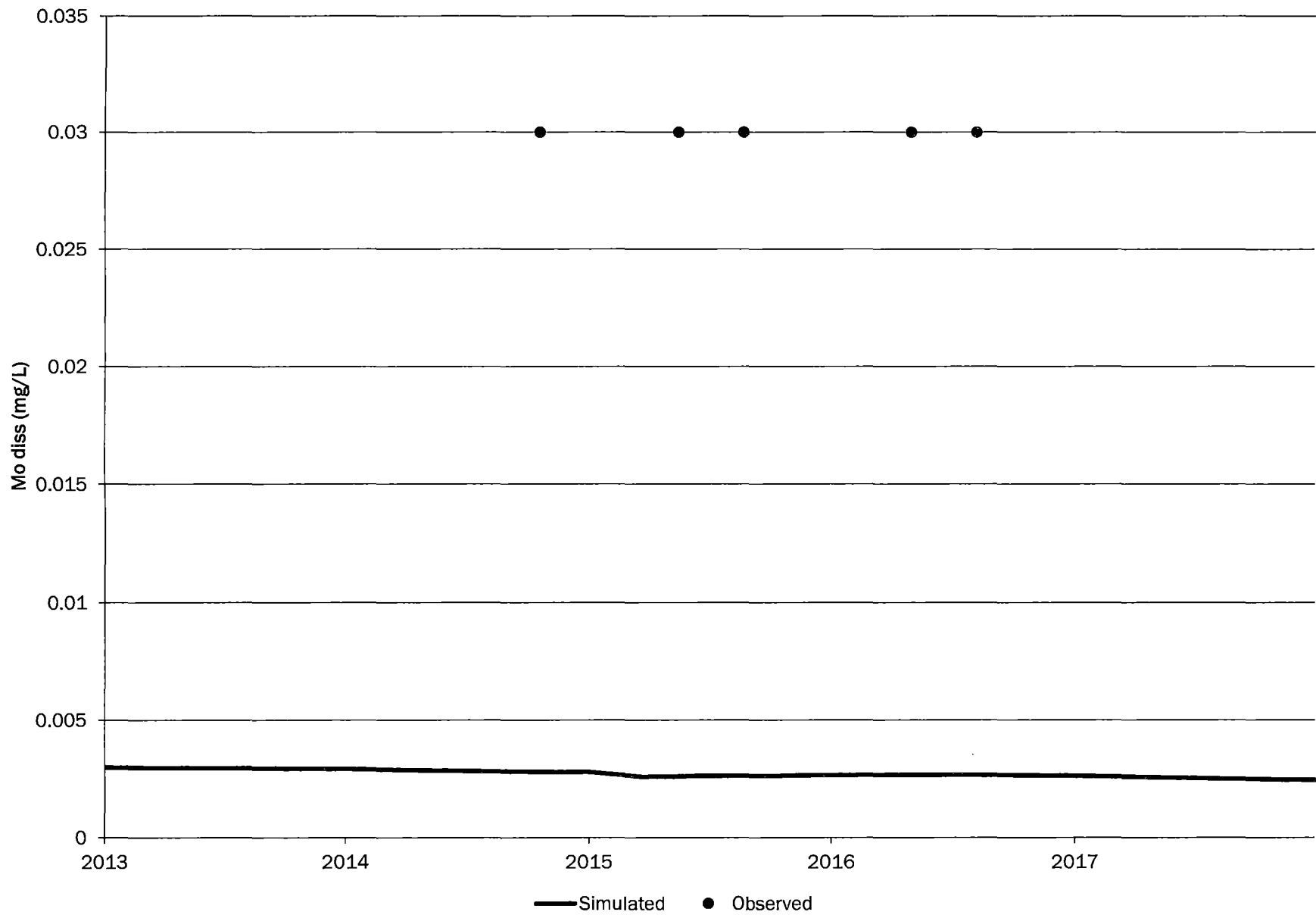
0862-AI



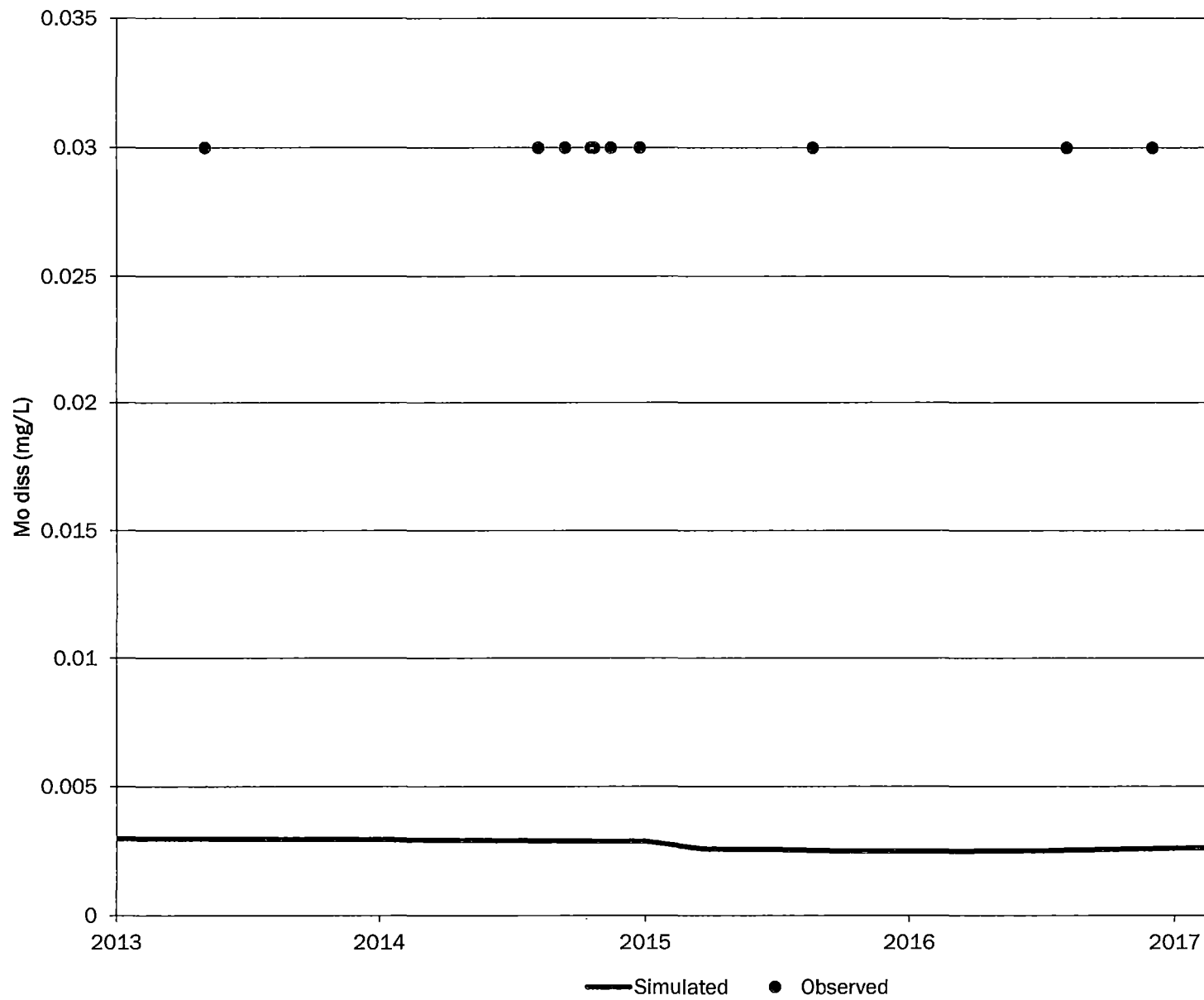
0864-AI



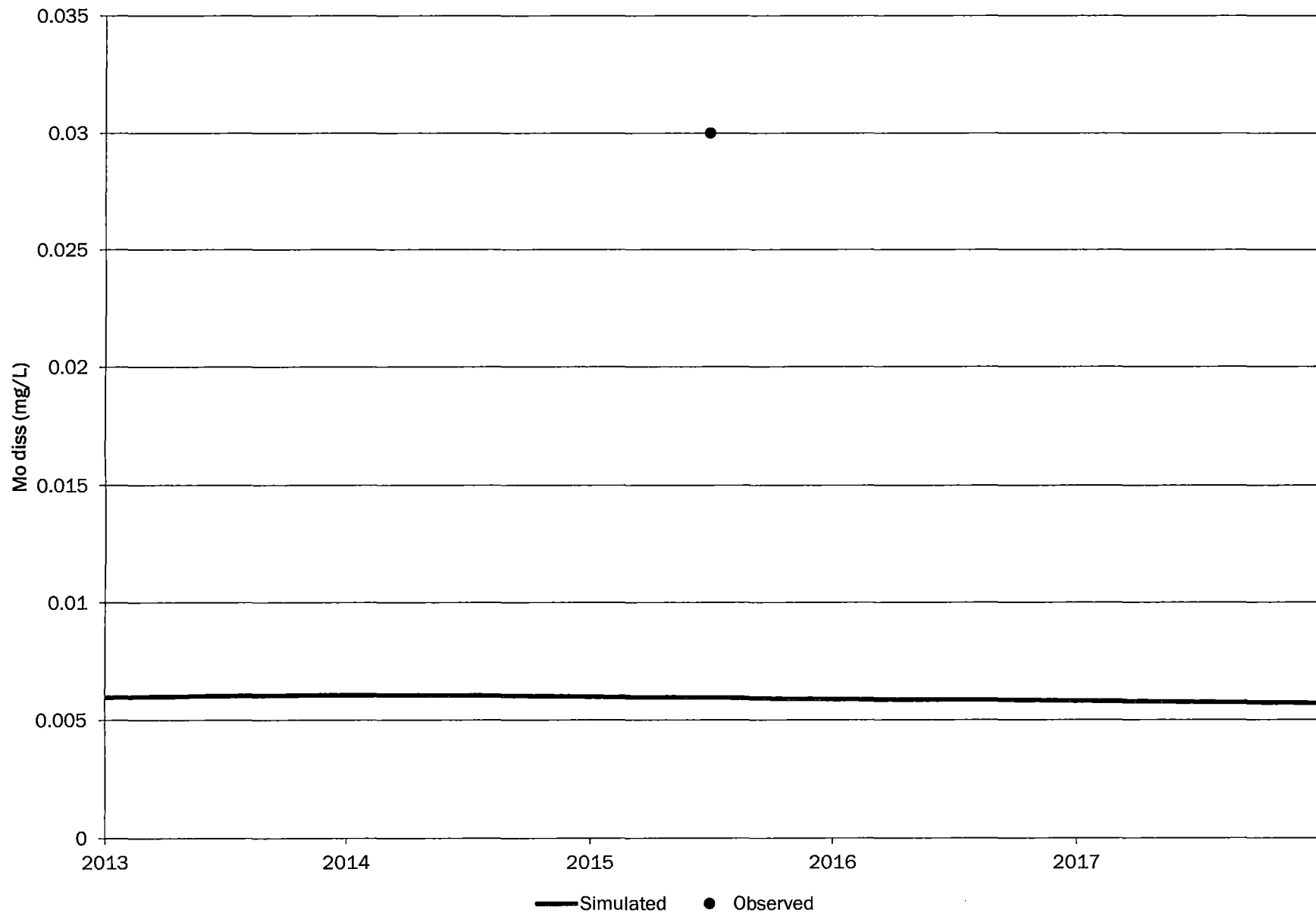
0865-AI



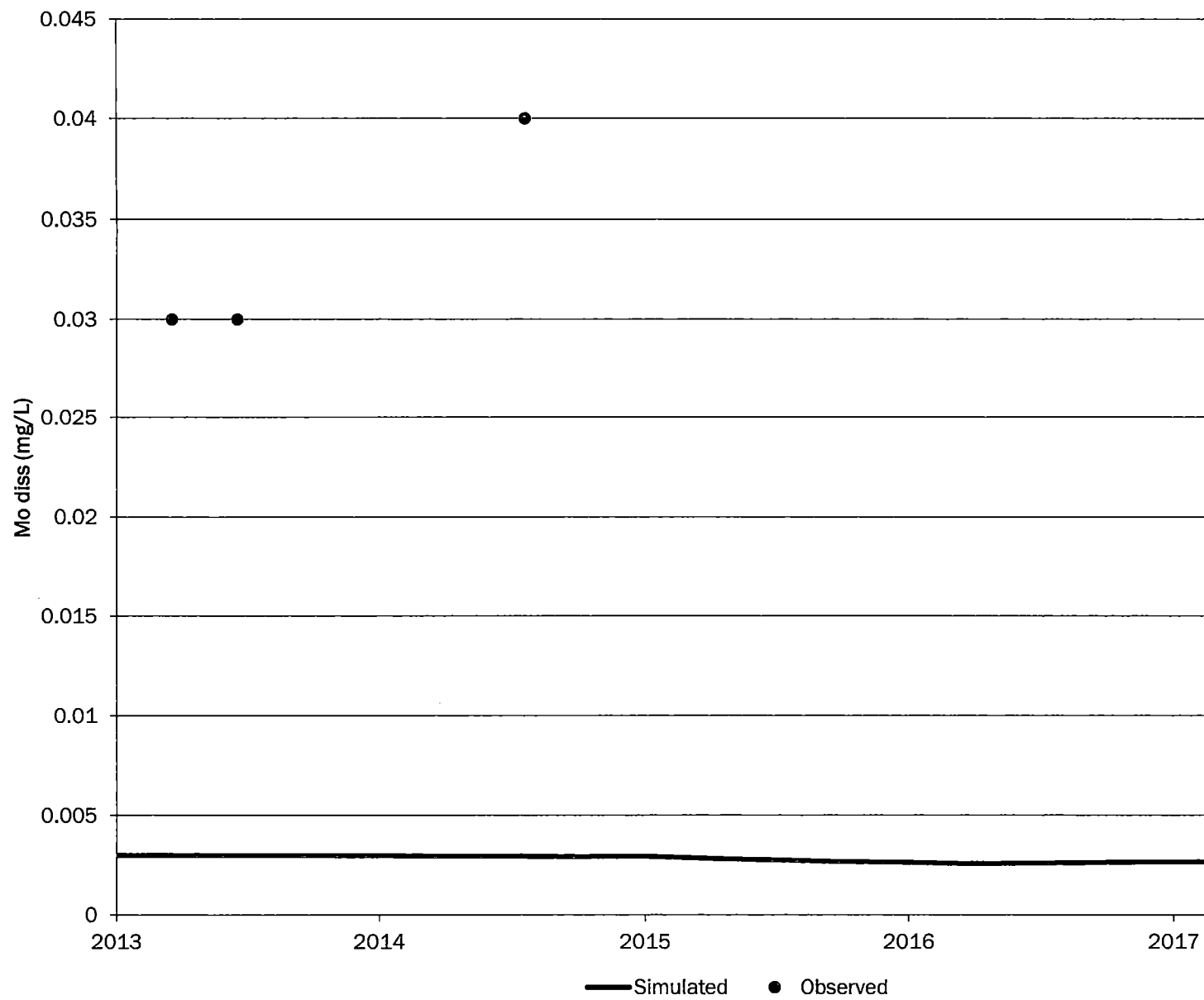
0866-AI



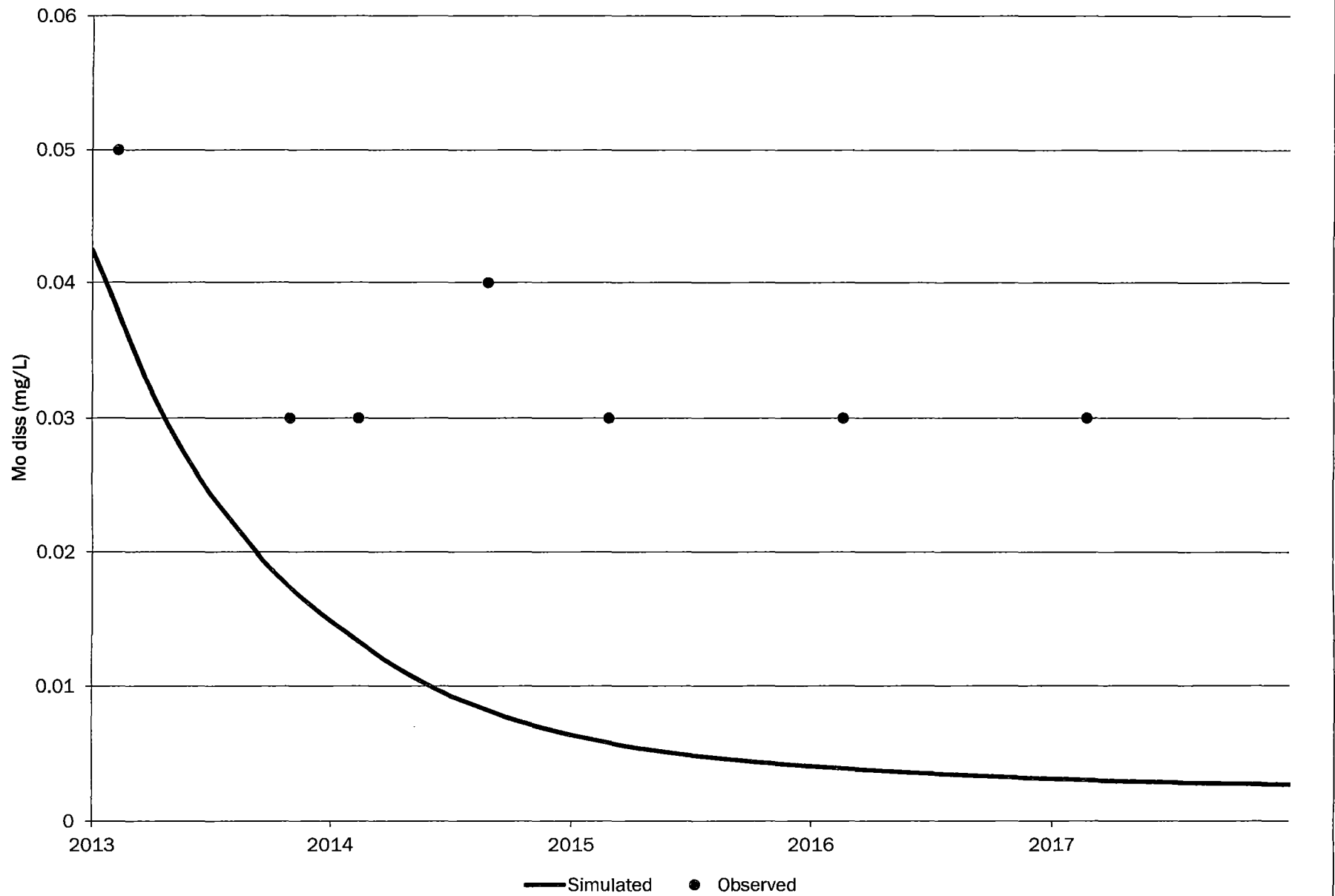
0868-AI



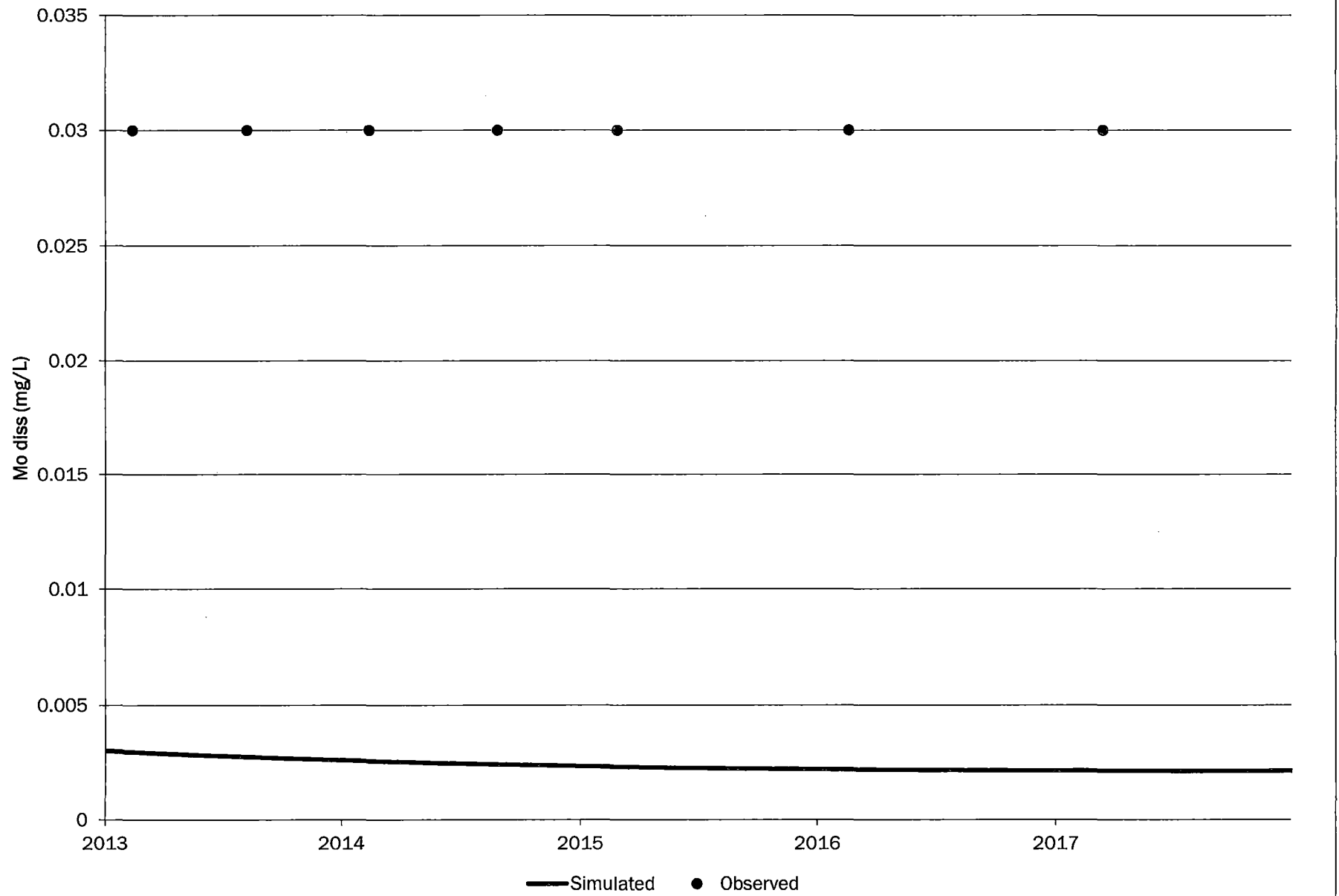
0869-AI



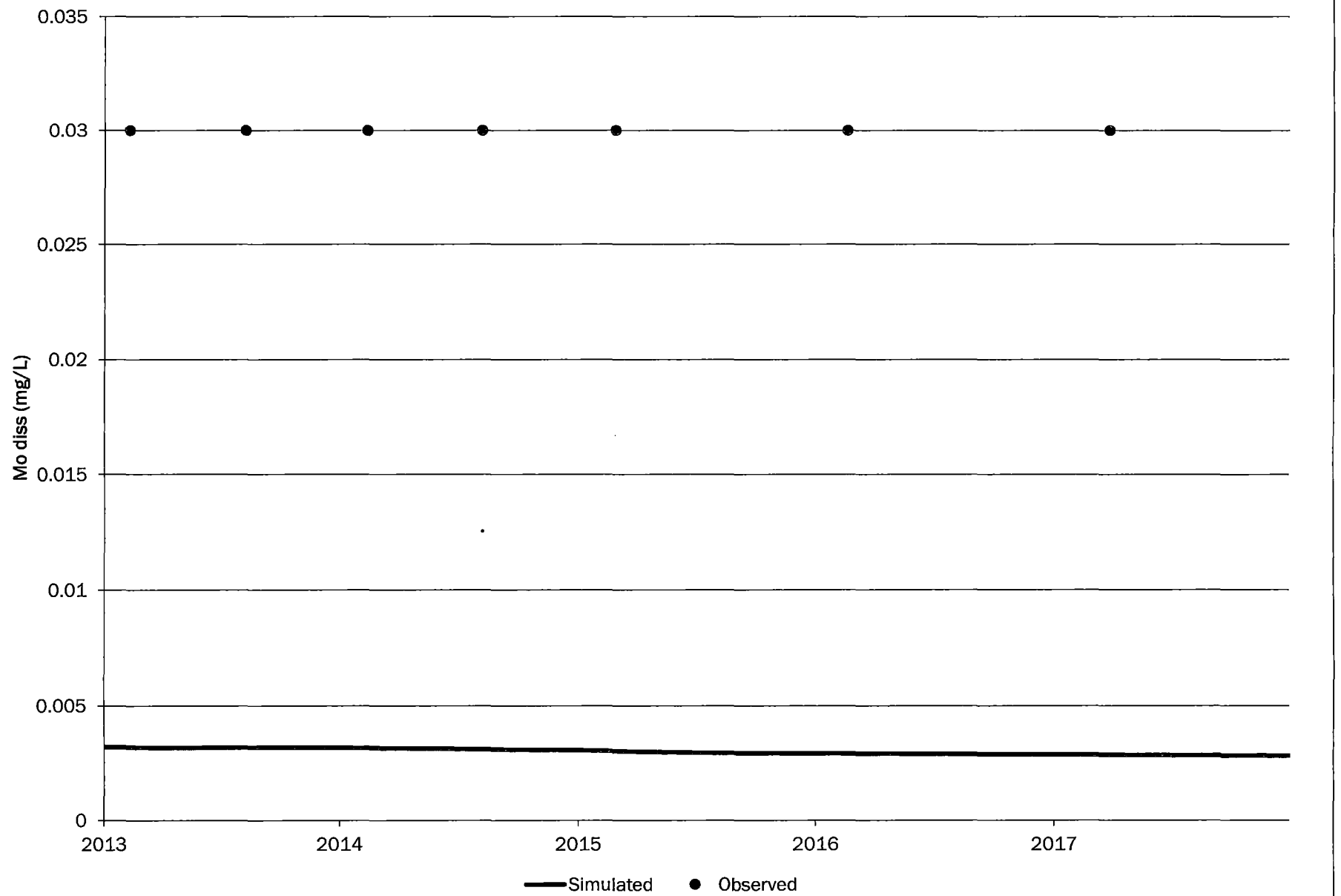
0881-AI



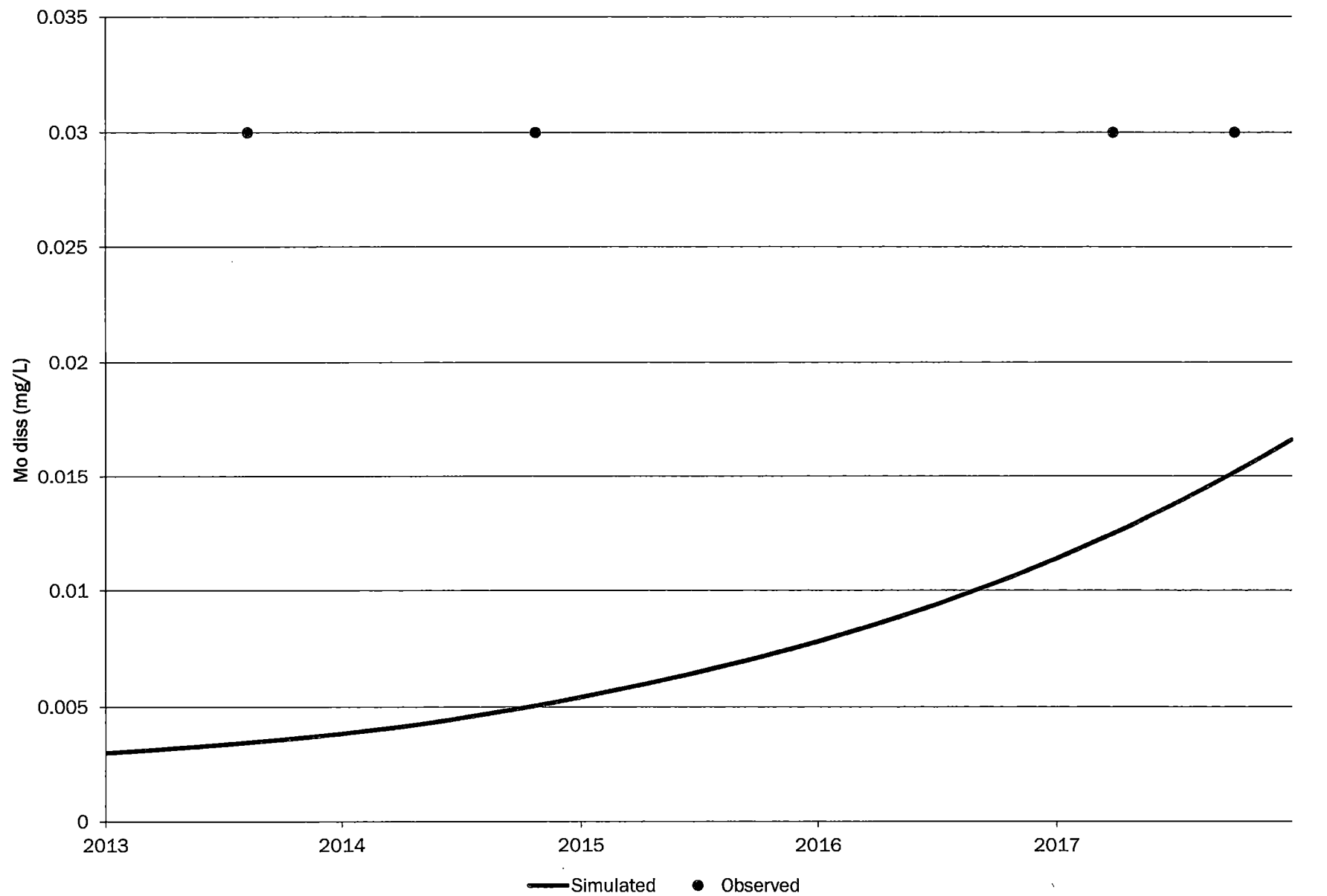
0882-AI



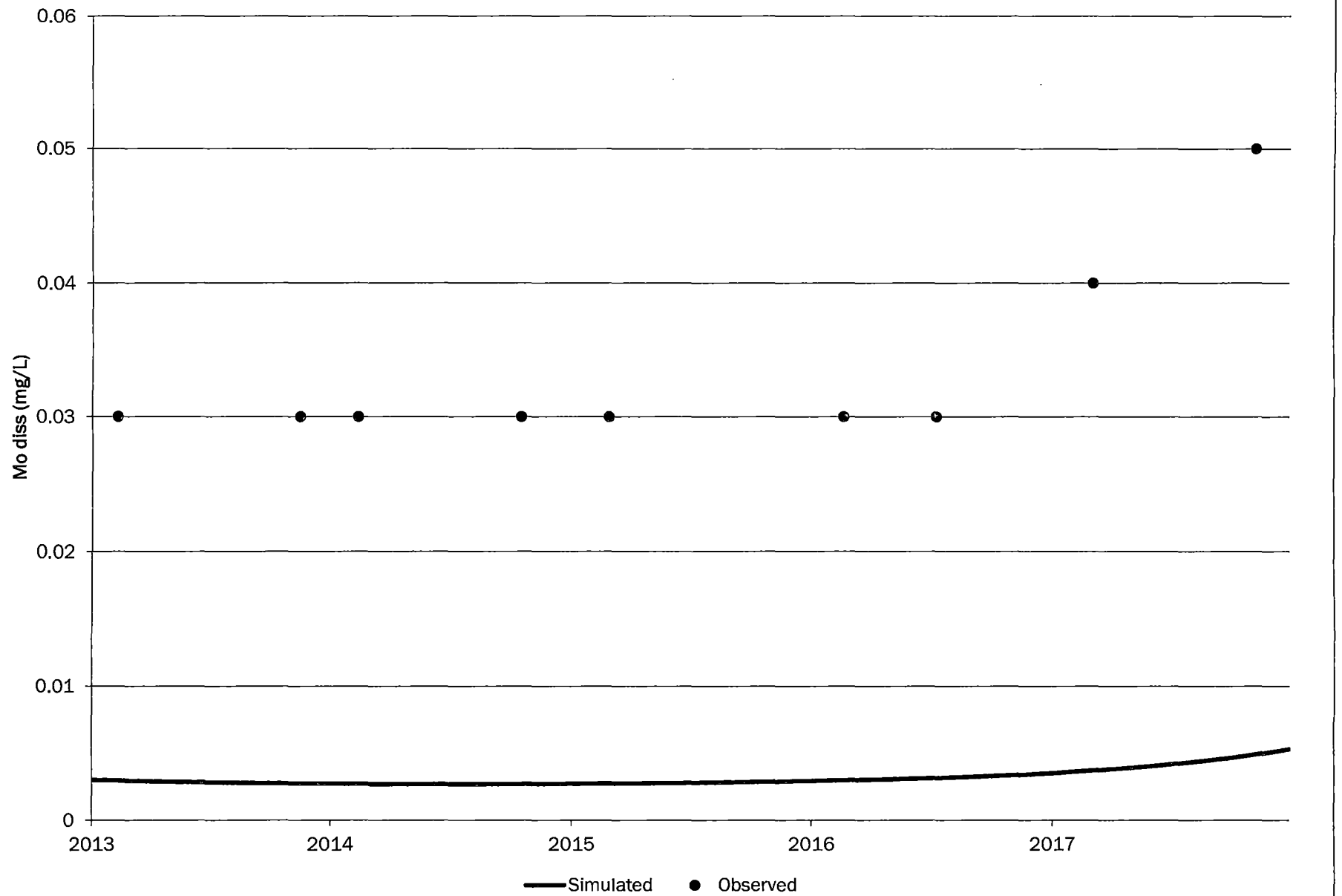
0884-AI



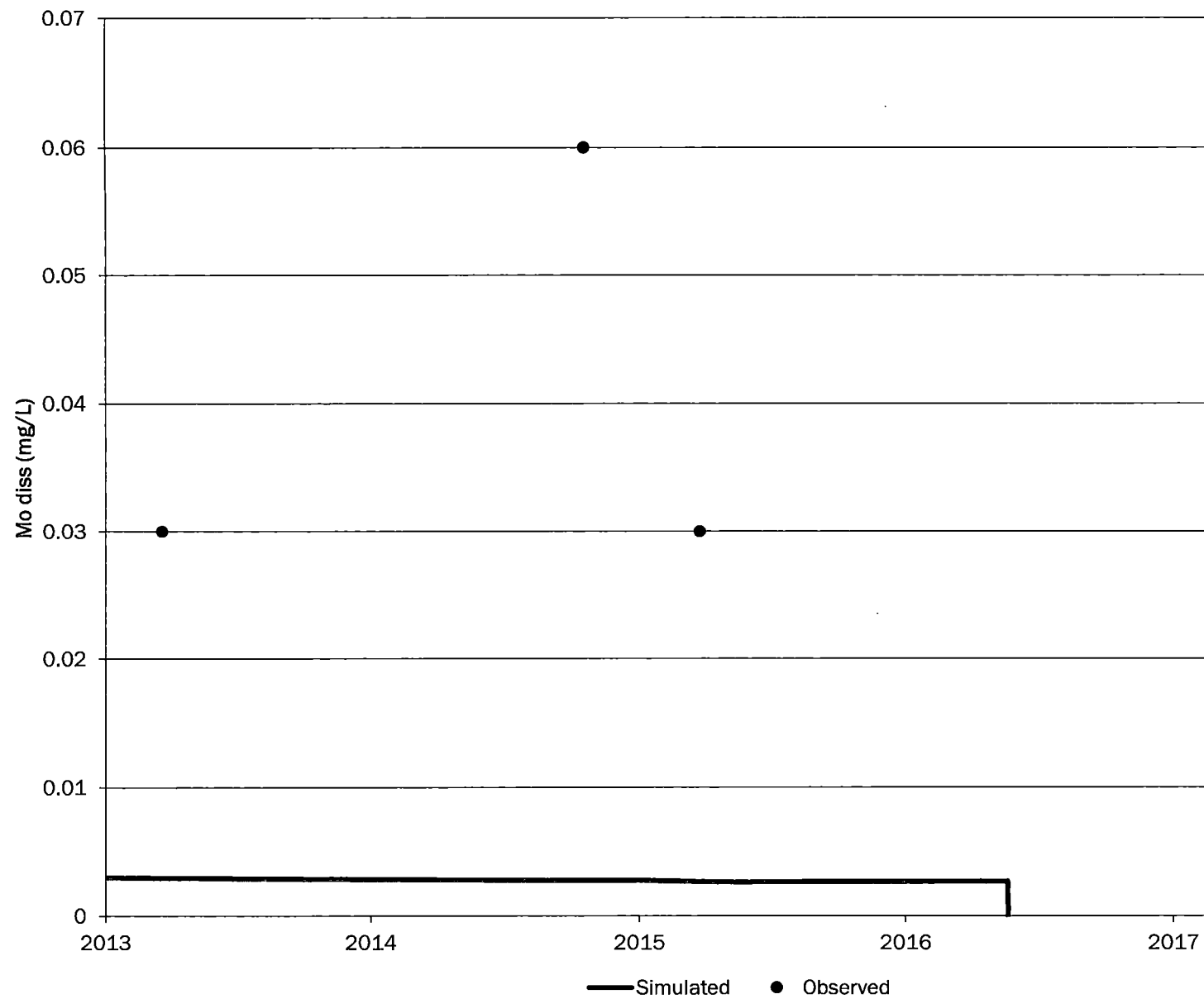
0885-AI



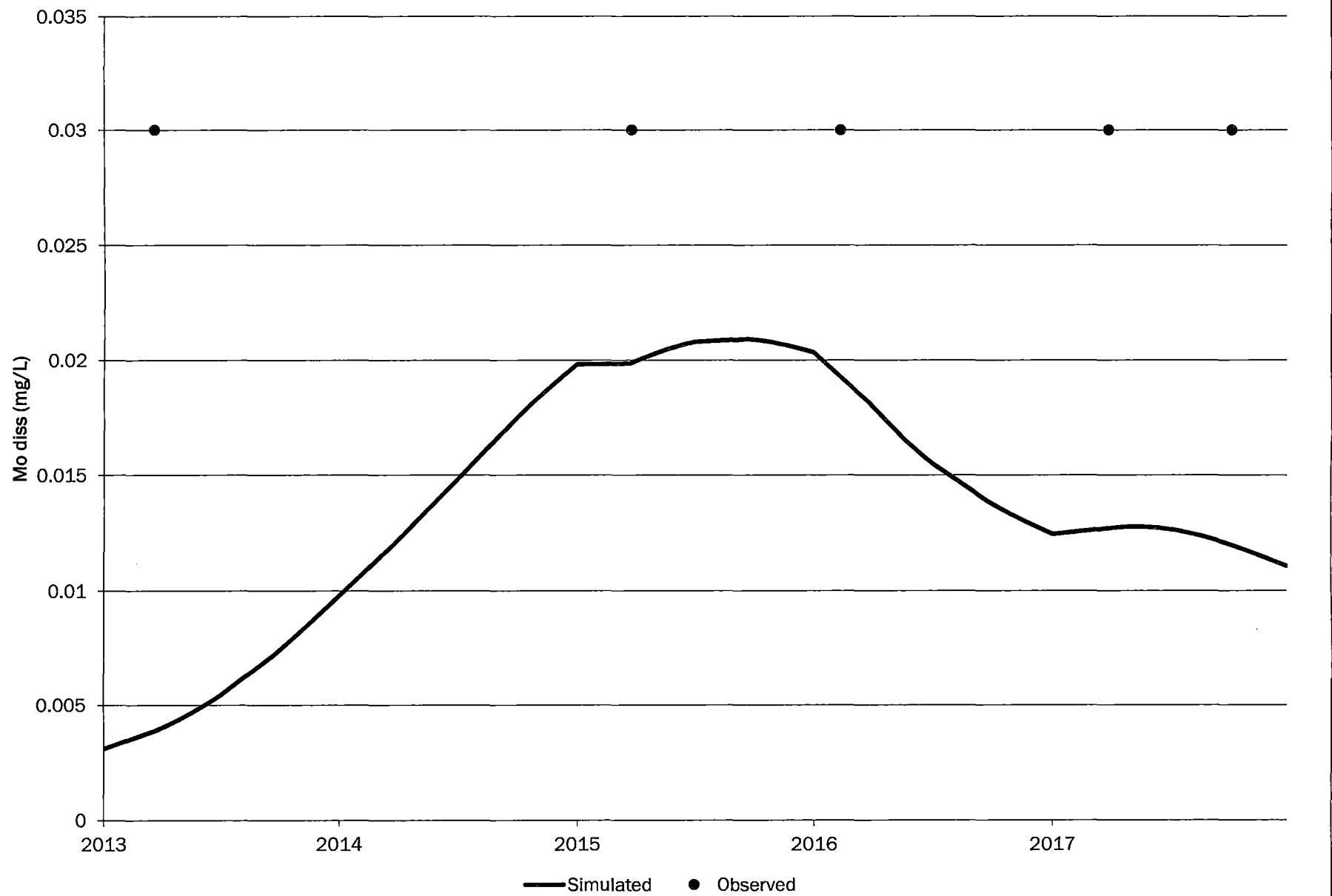
0886-AI



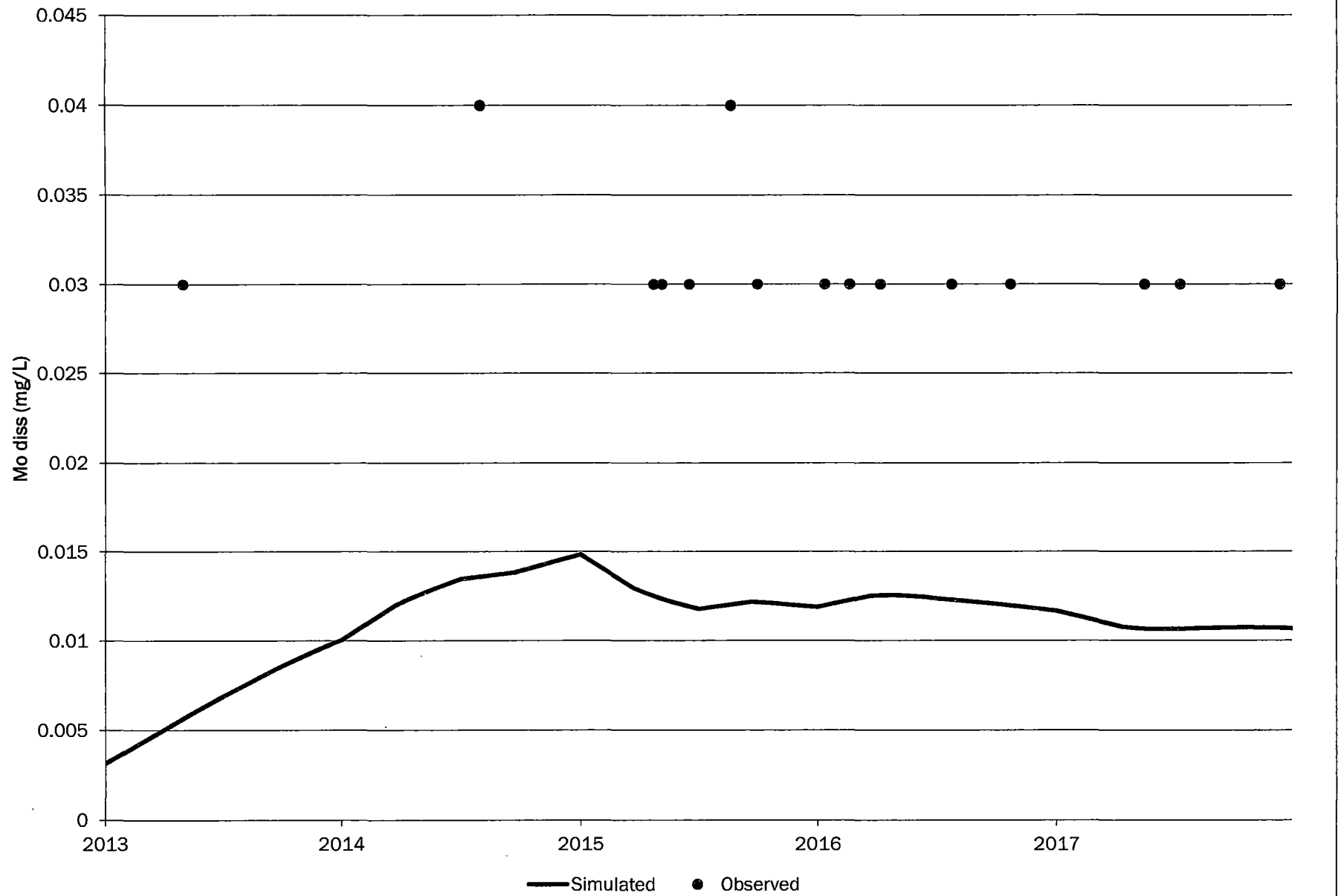
0887-AI



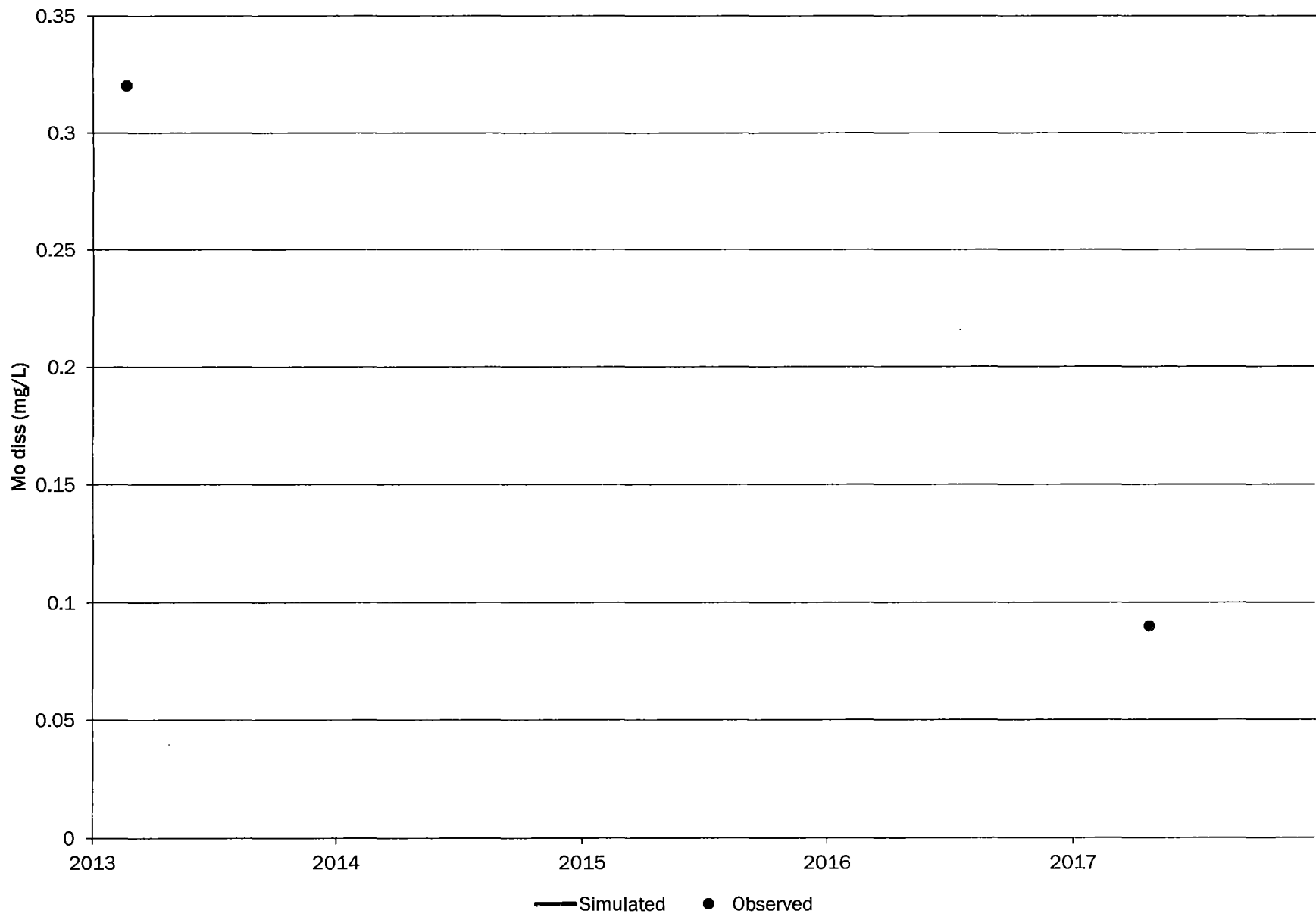
0888-AI



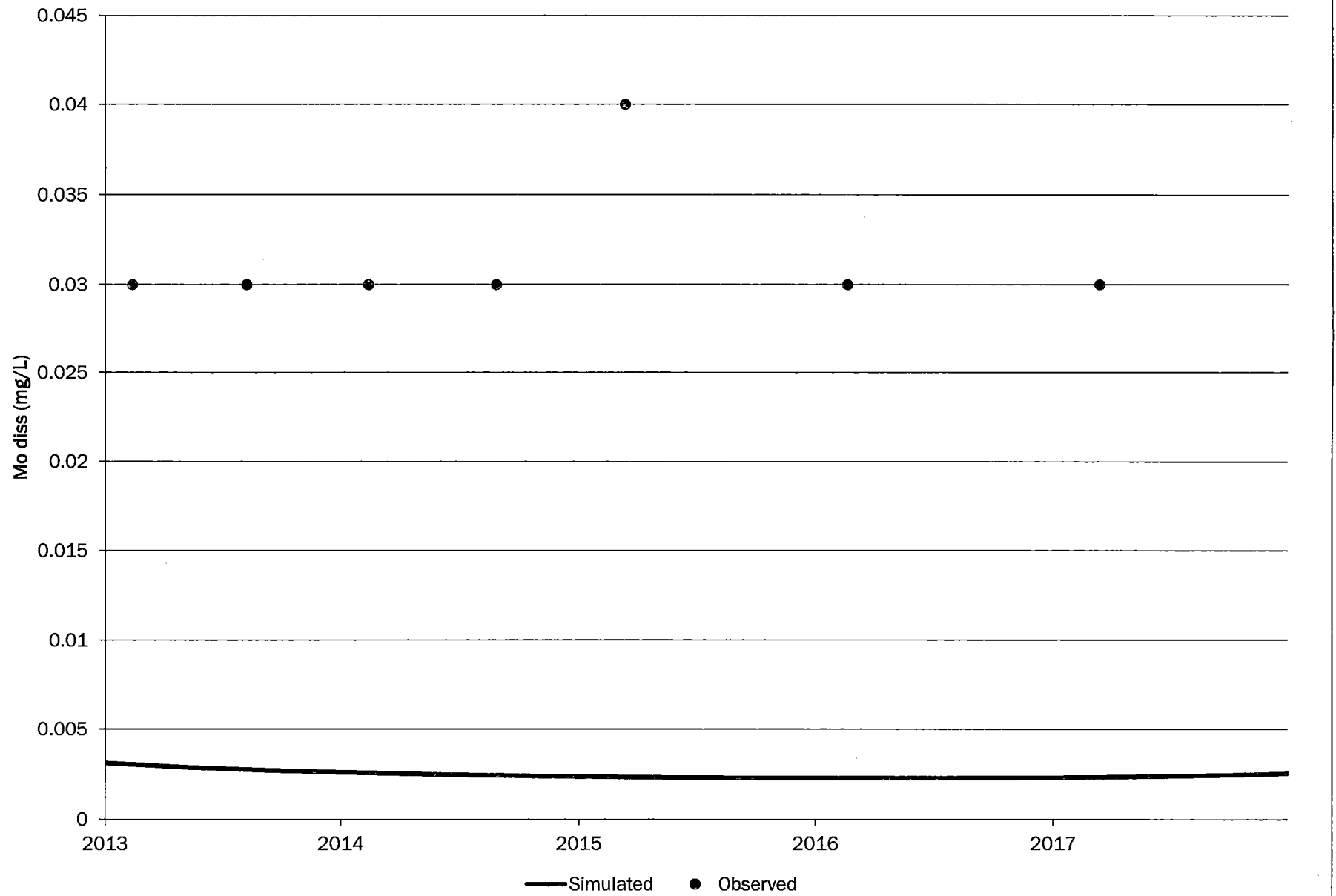
0890-AI



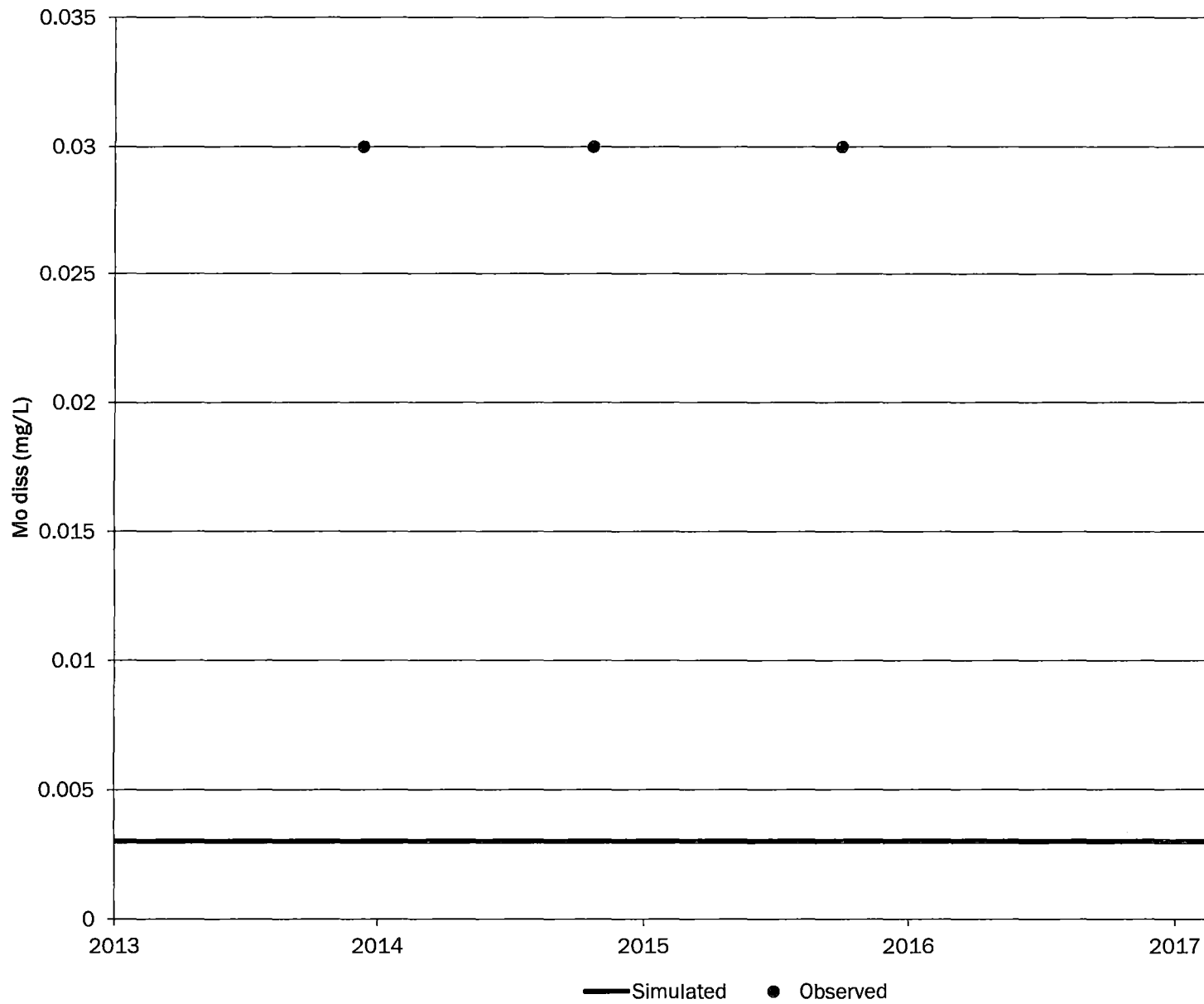
0891-AI



0893-AI



0910-AI



0920-AI

0.035

0.03

0.025

0.02
Mo diss (mg/L)

0.015

0.01

0.005

0

2013

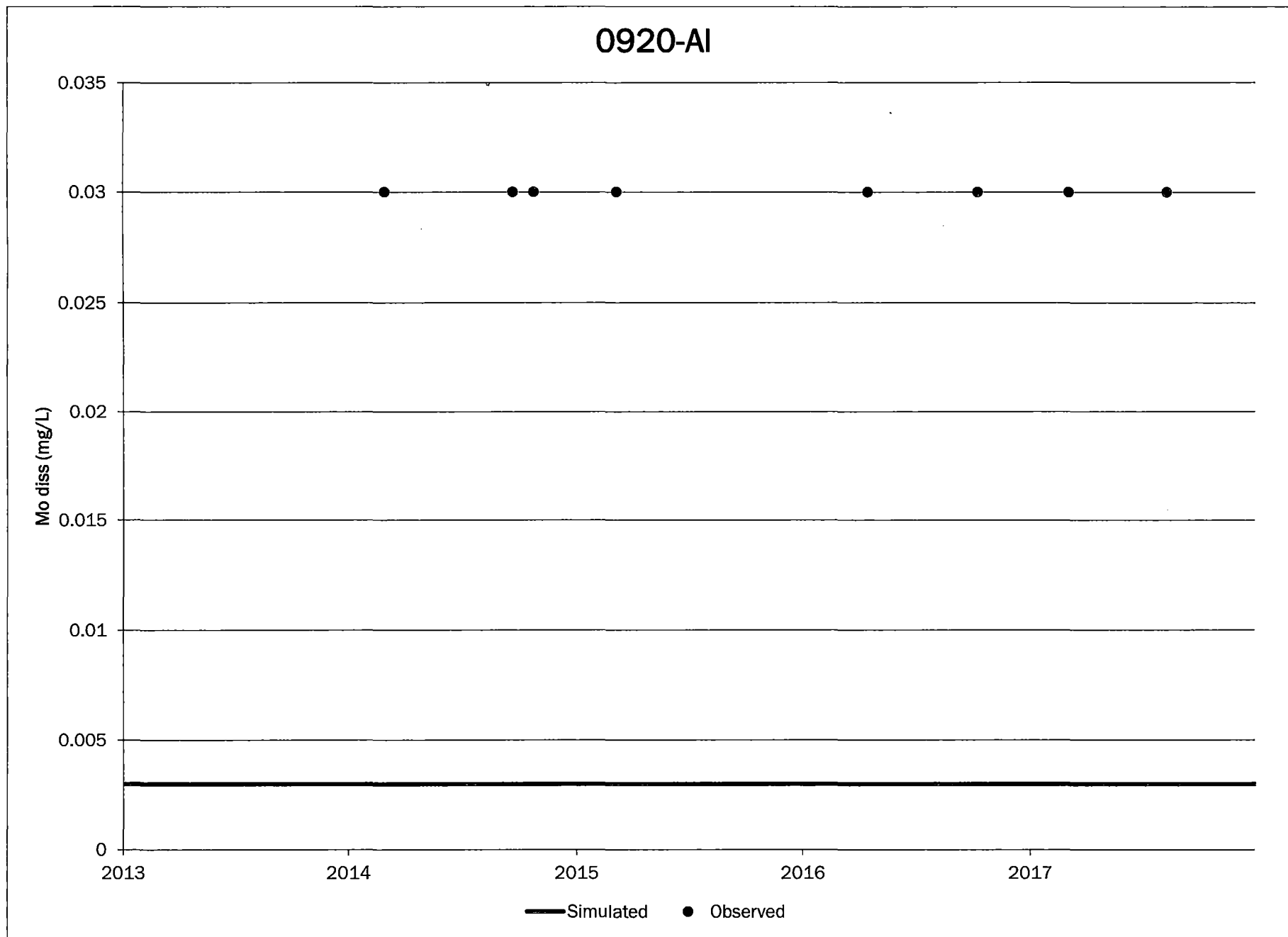
2014

2015

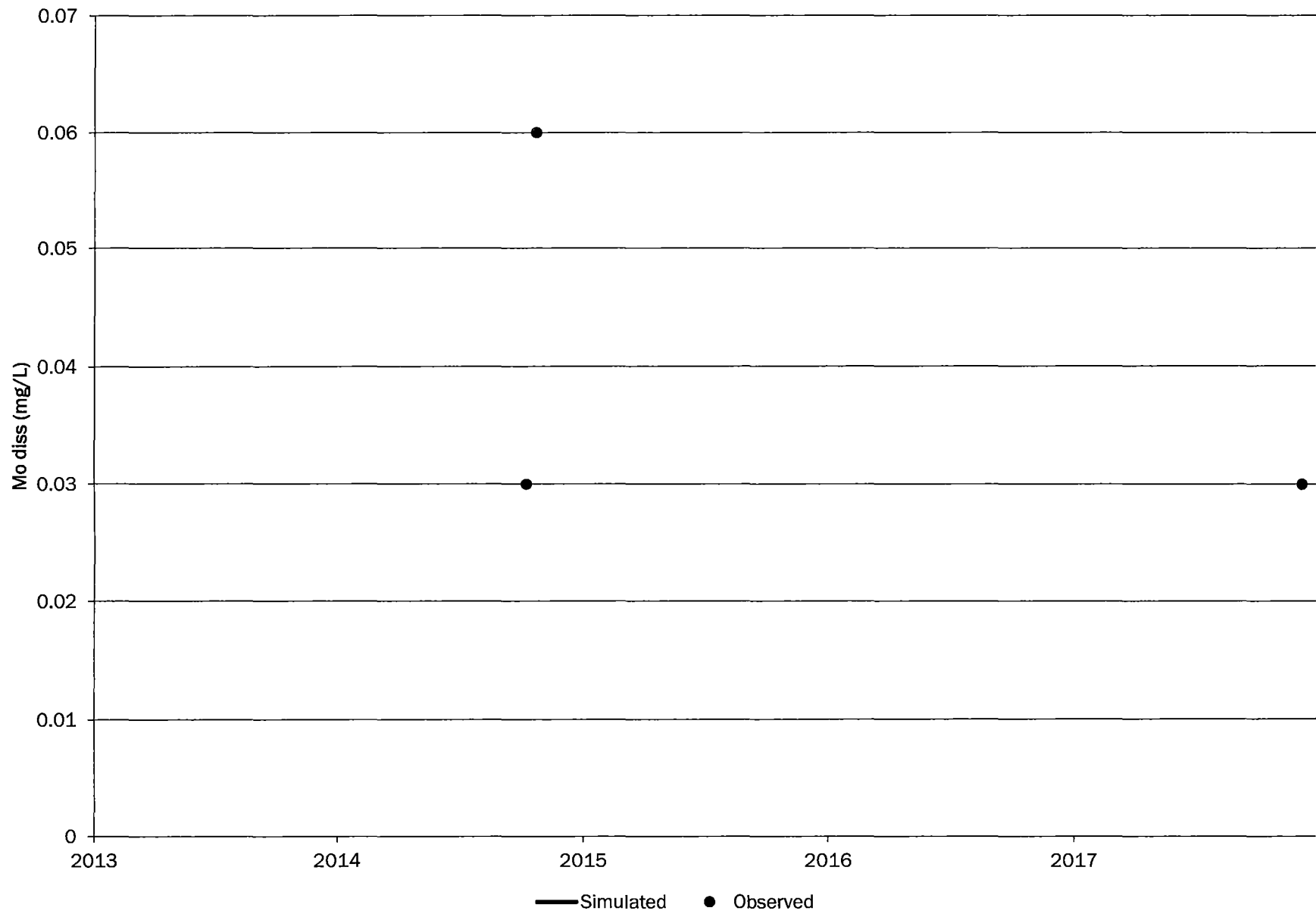
2016

2017

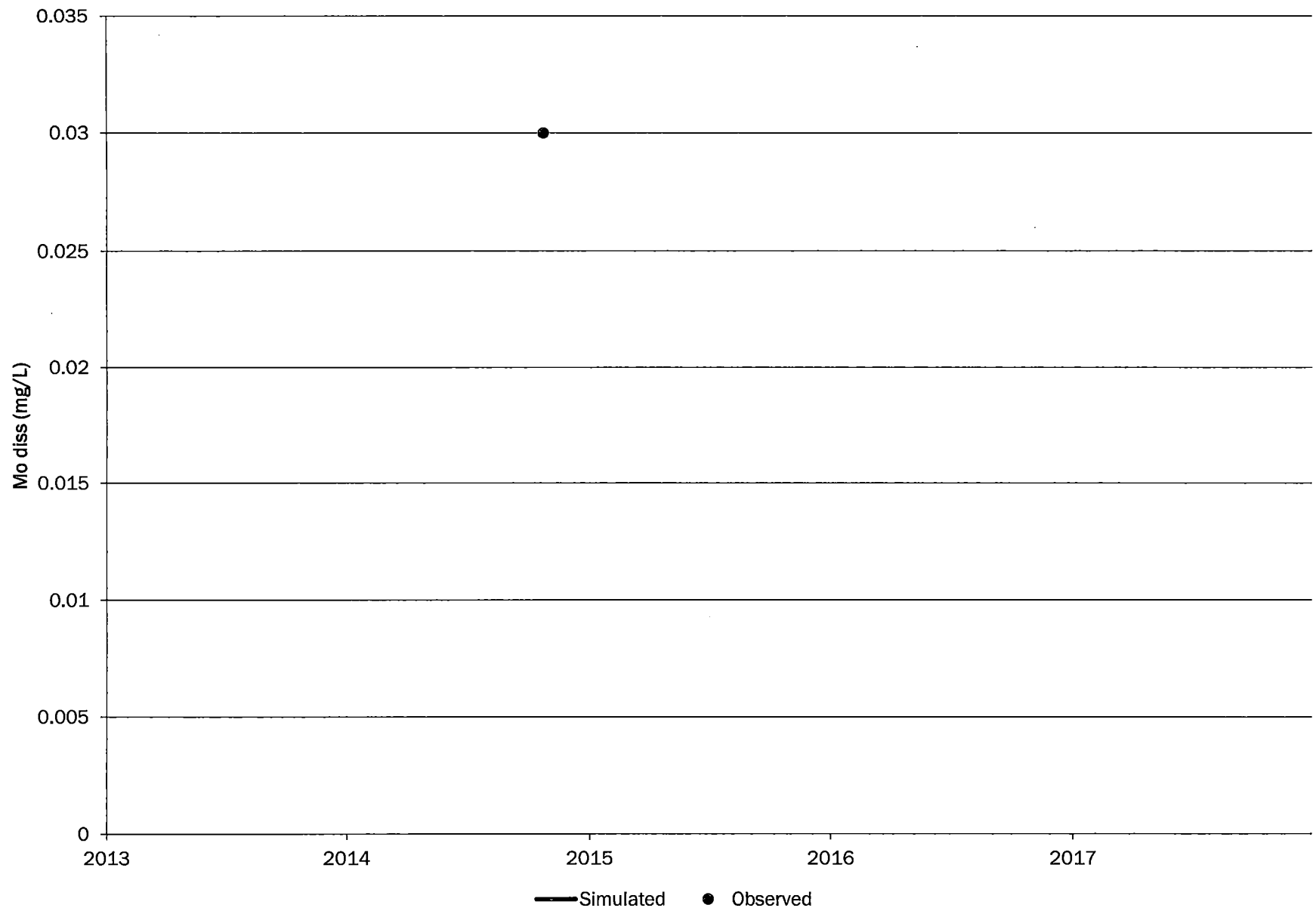
— Simulated • Observed



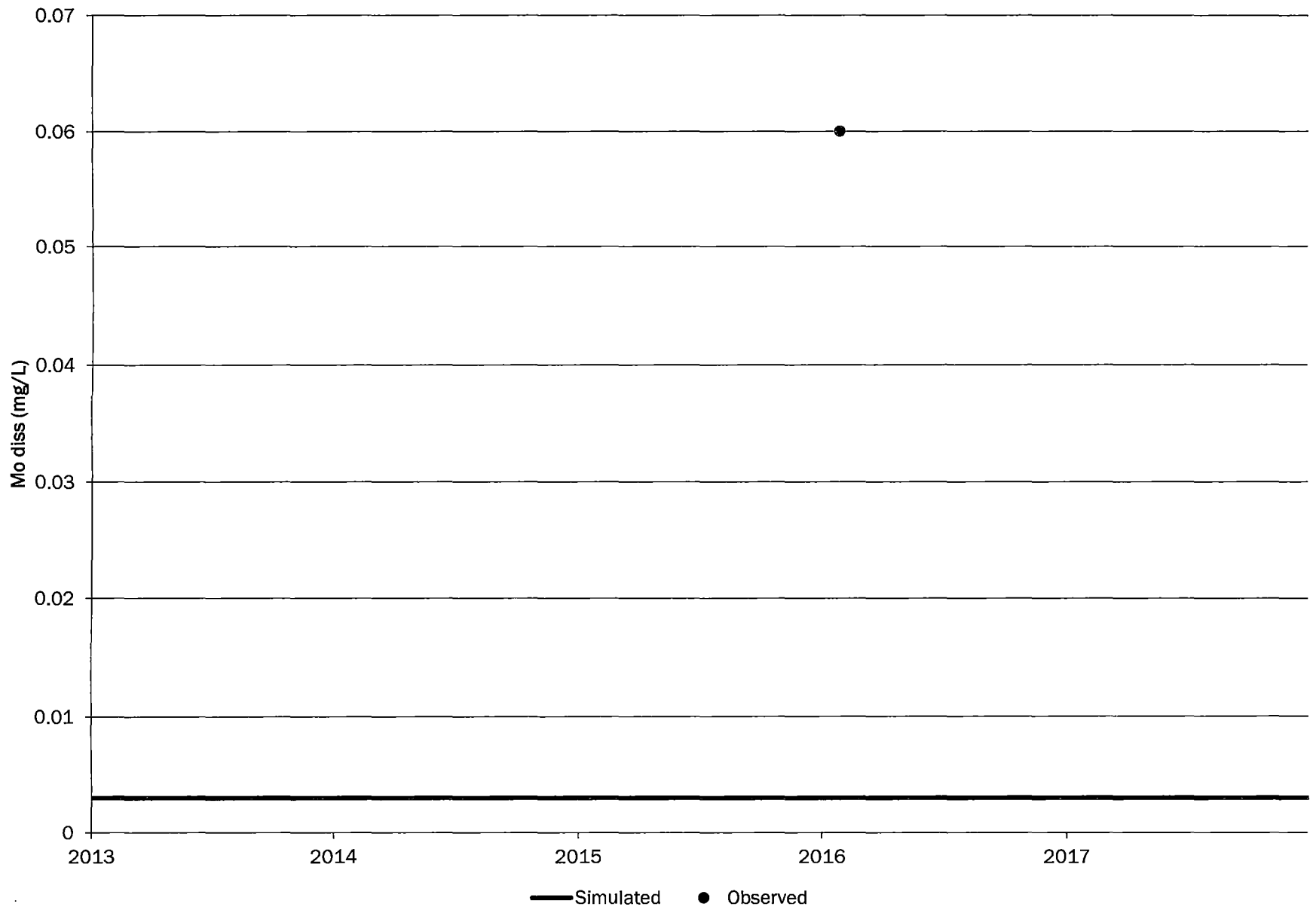
0921-AI



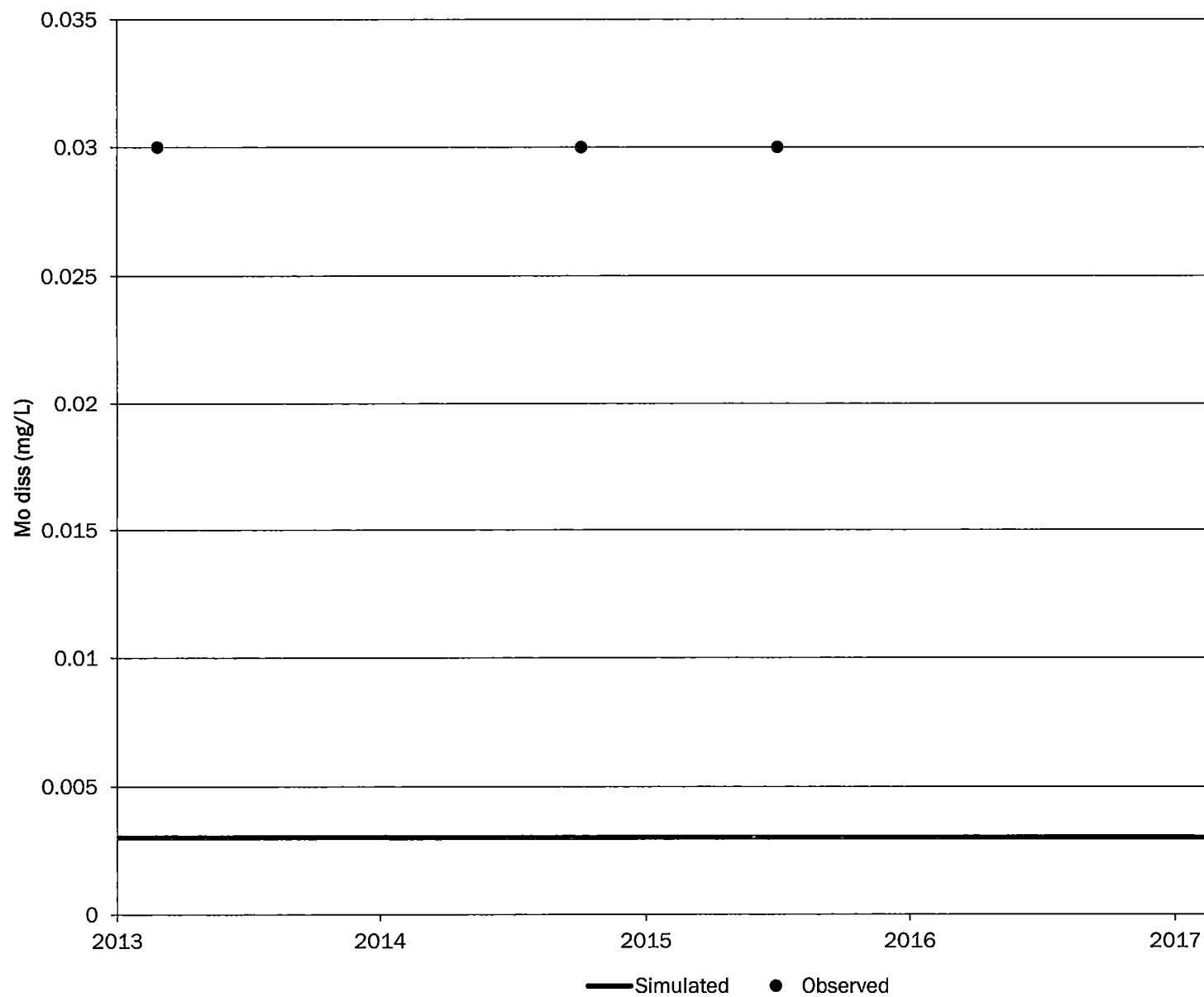
0922-AI



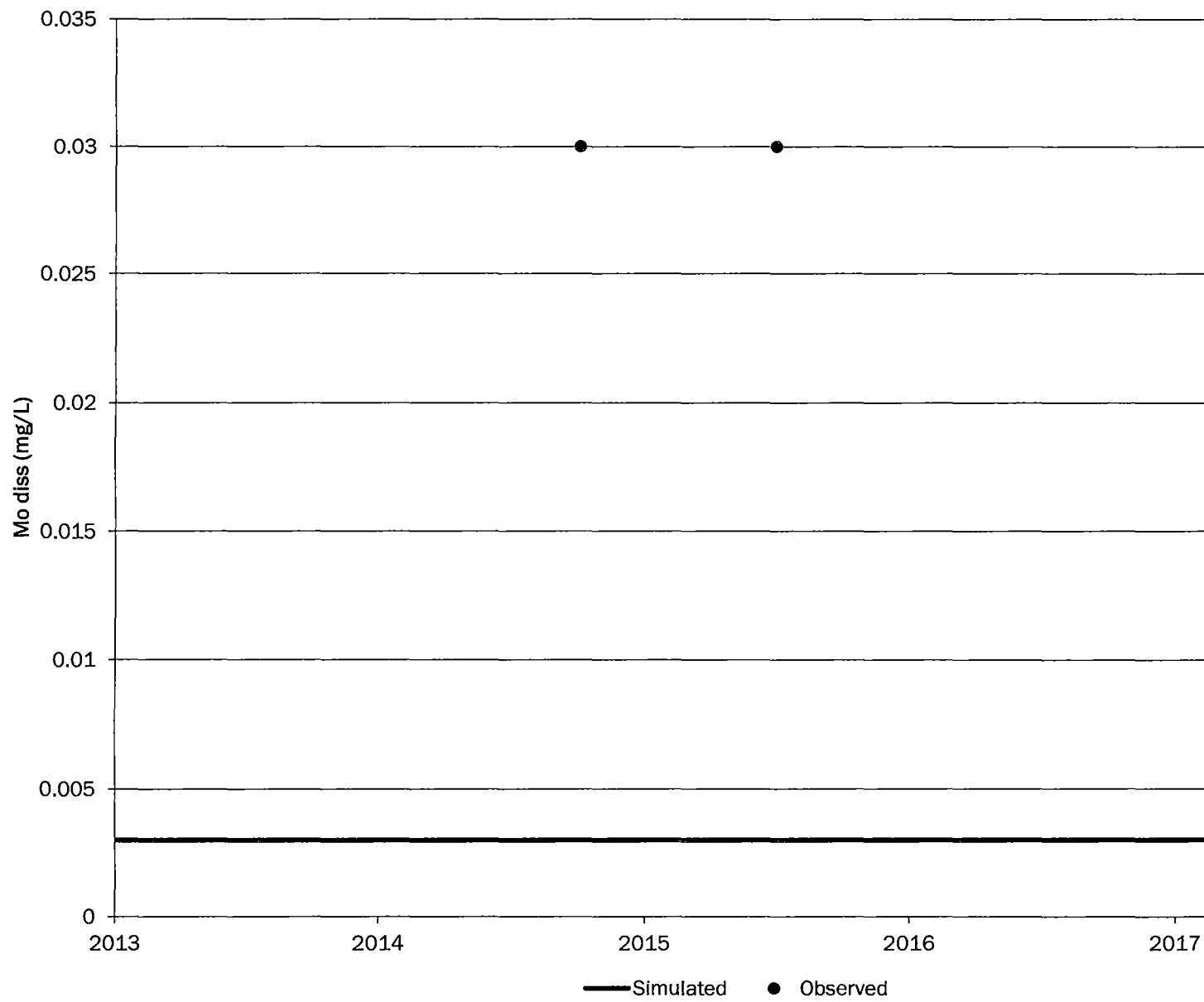
0928-SA



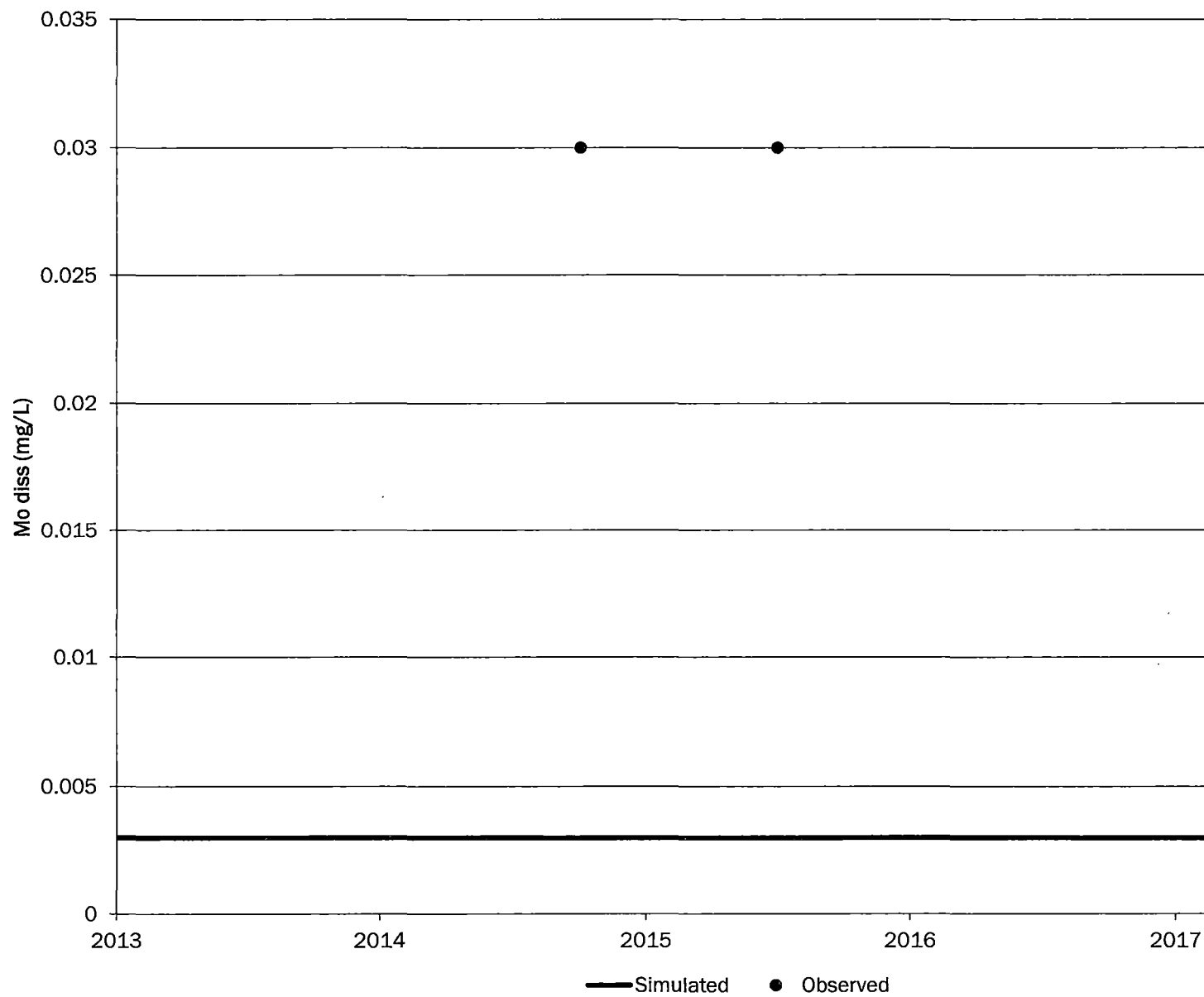
0929-UC



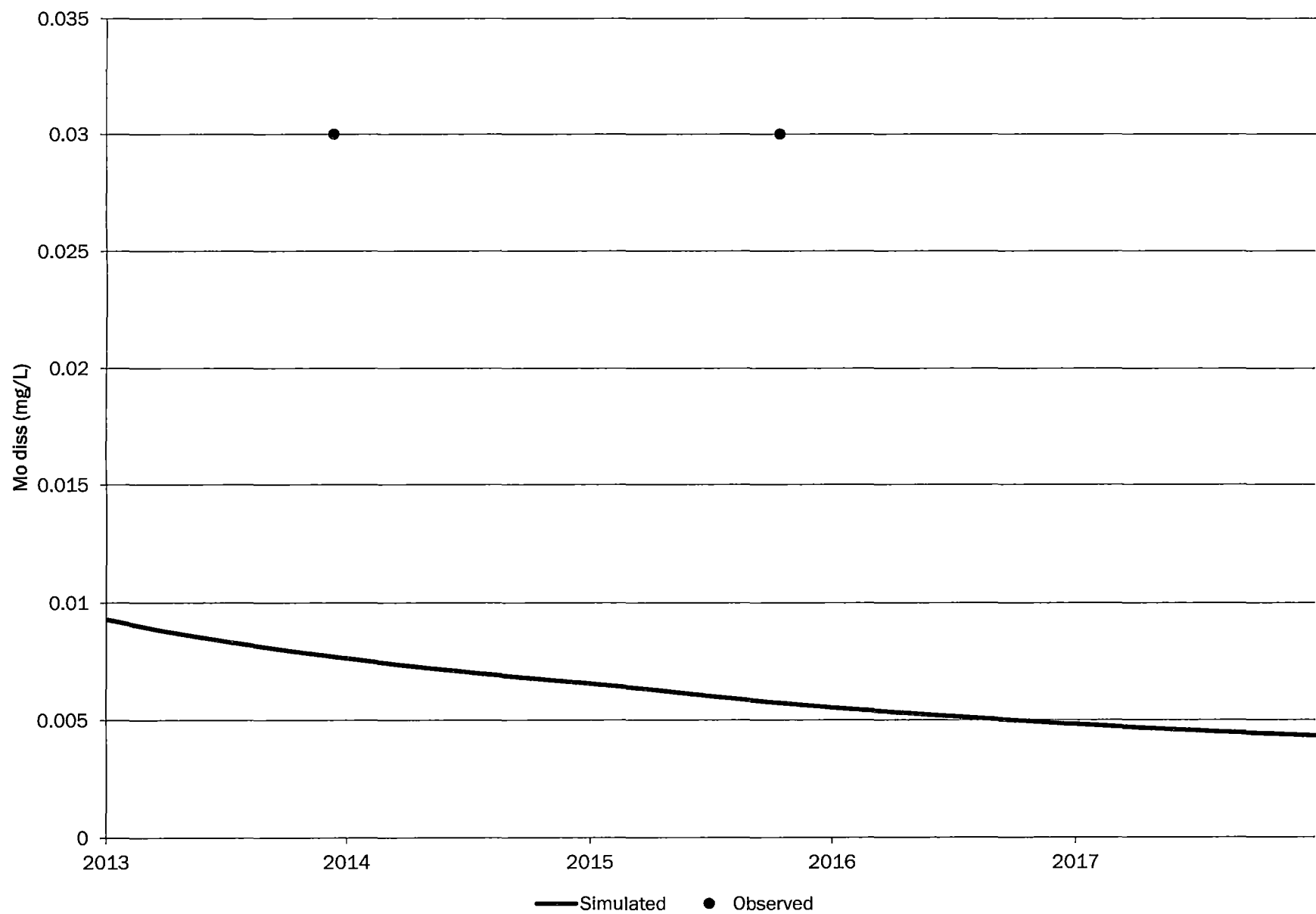
0930-MC



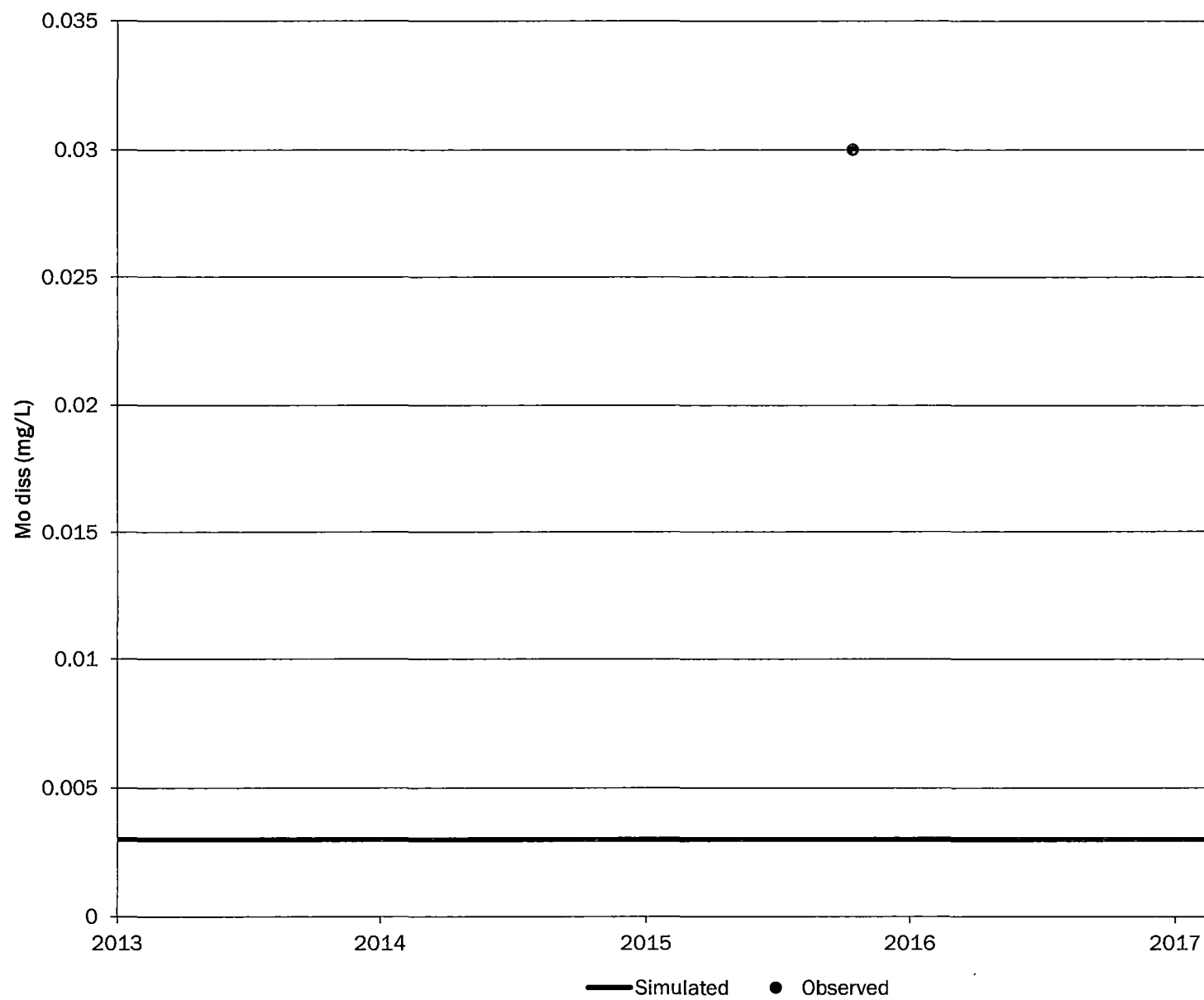
0931-UC



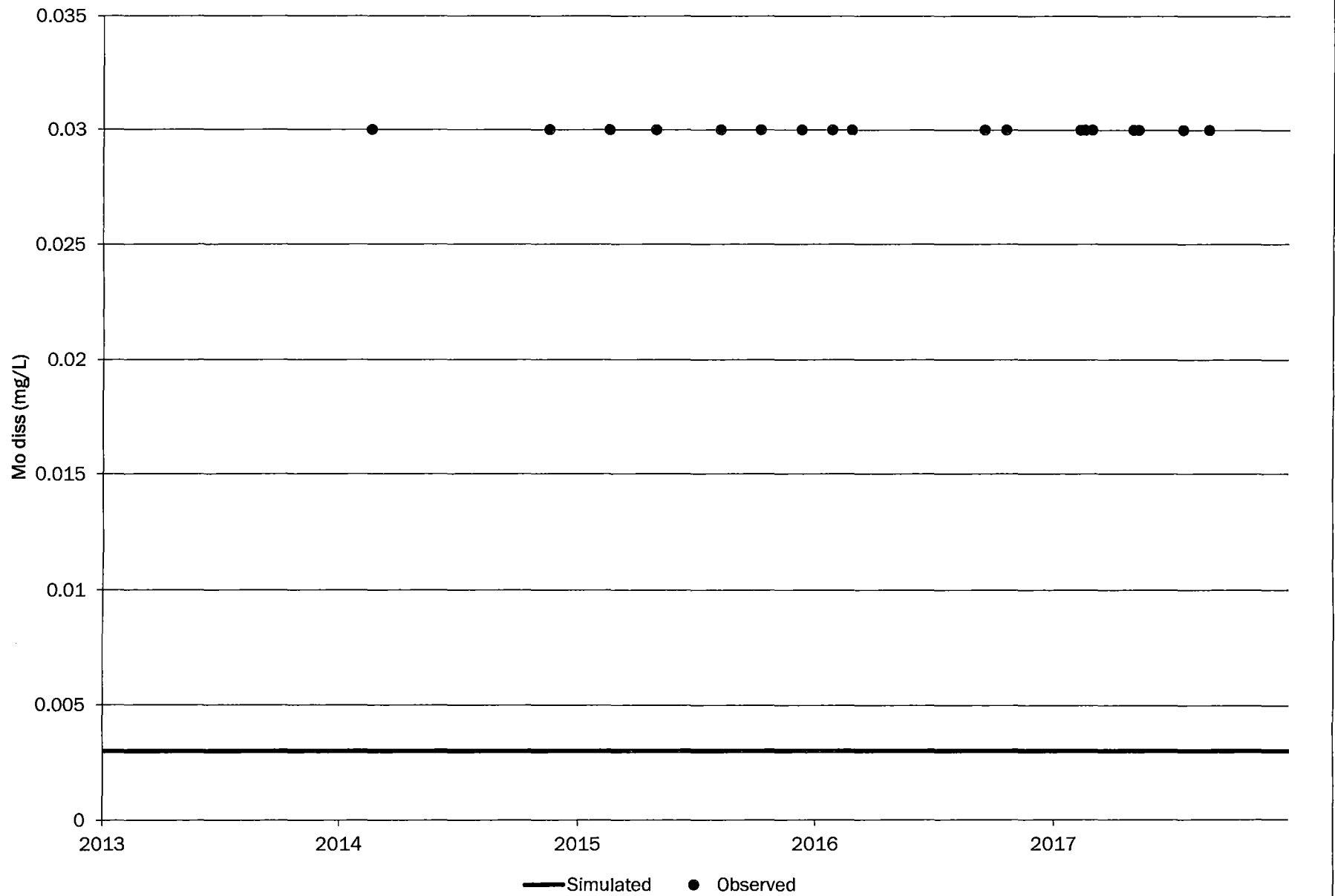
0935-AI



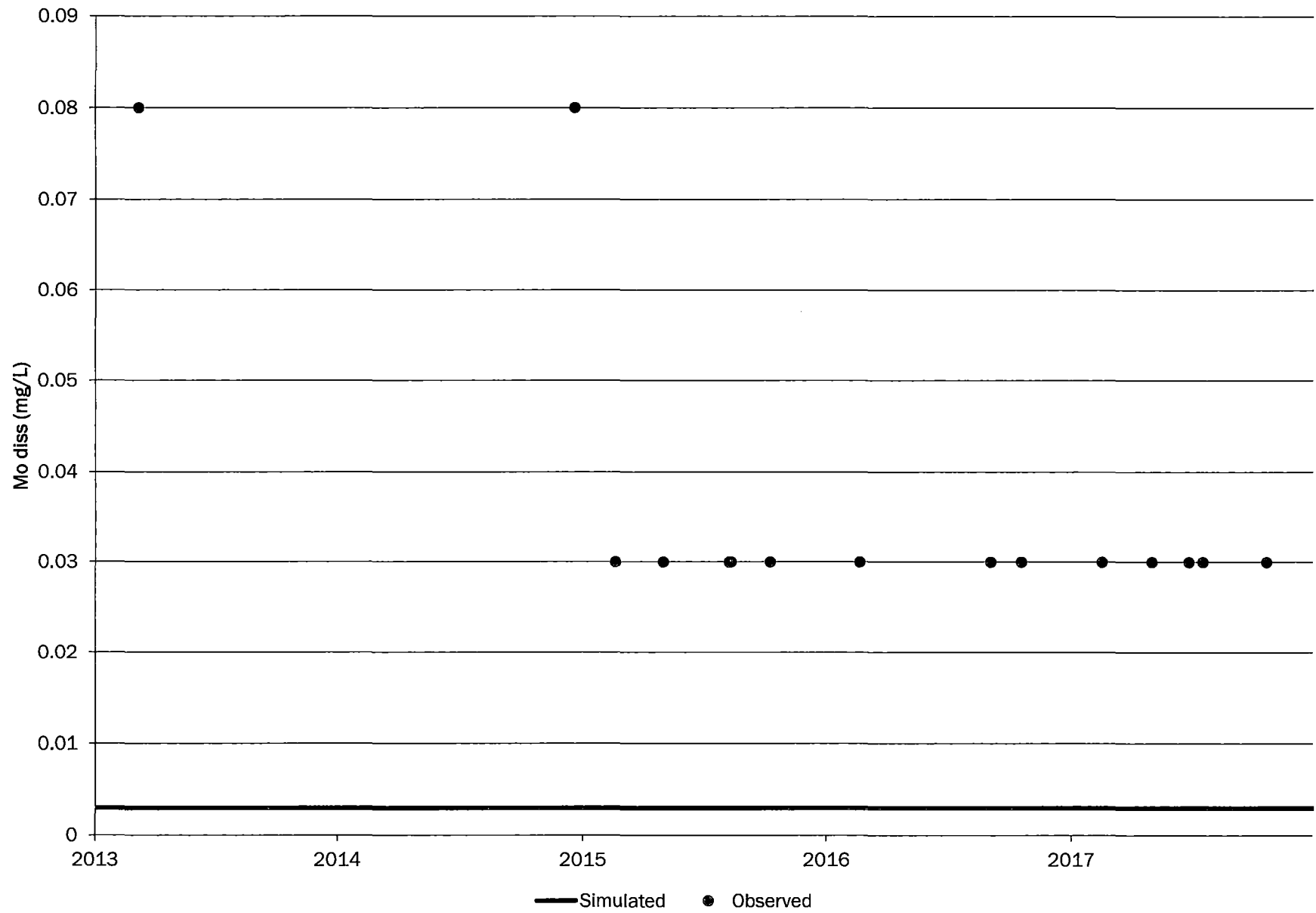
0938-SA



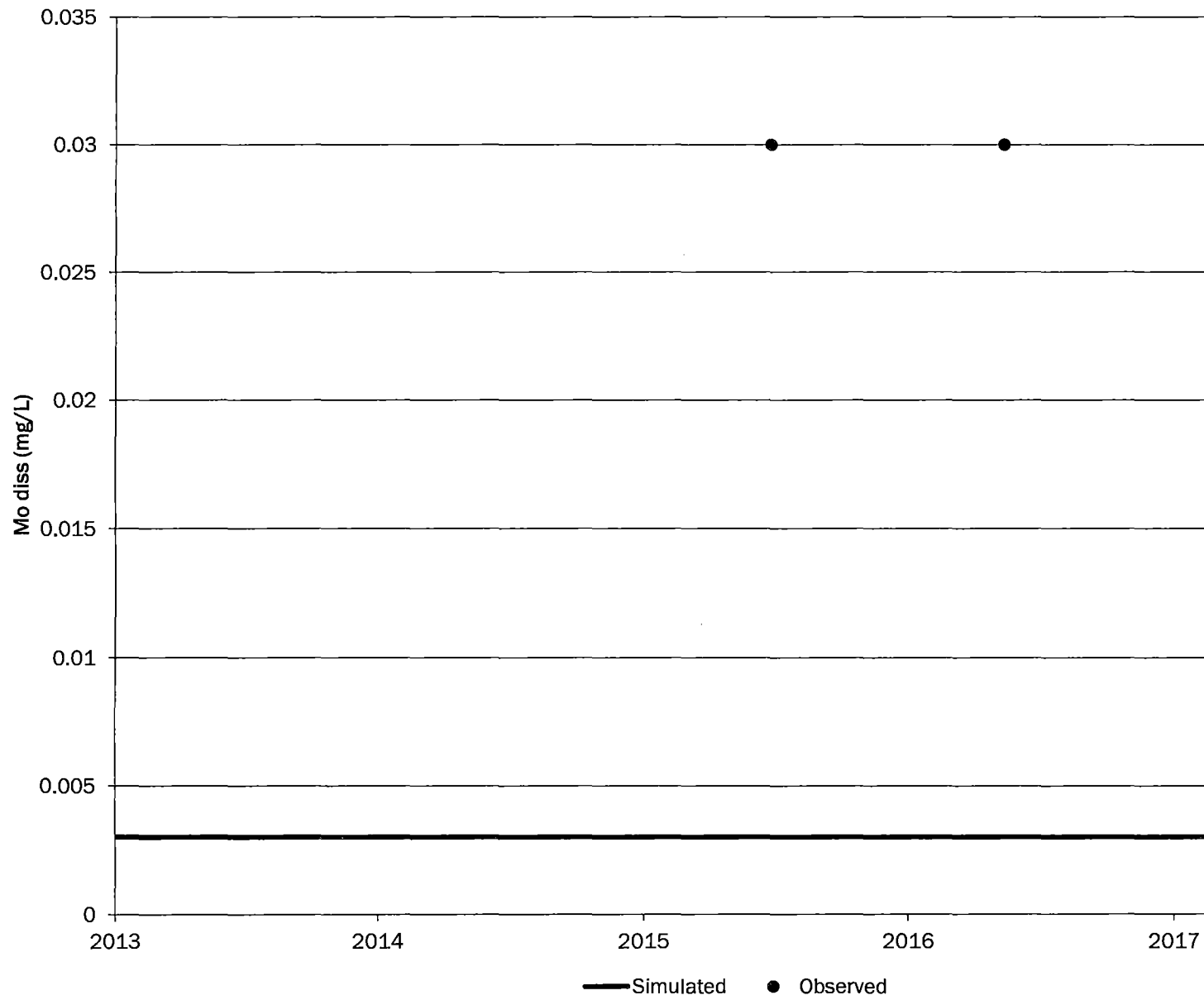
0943-SA



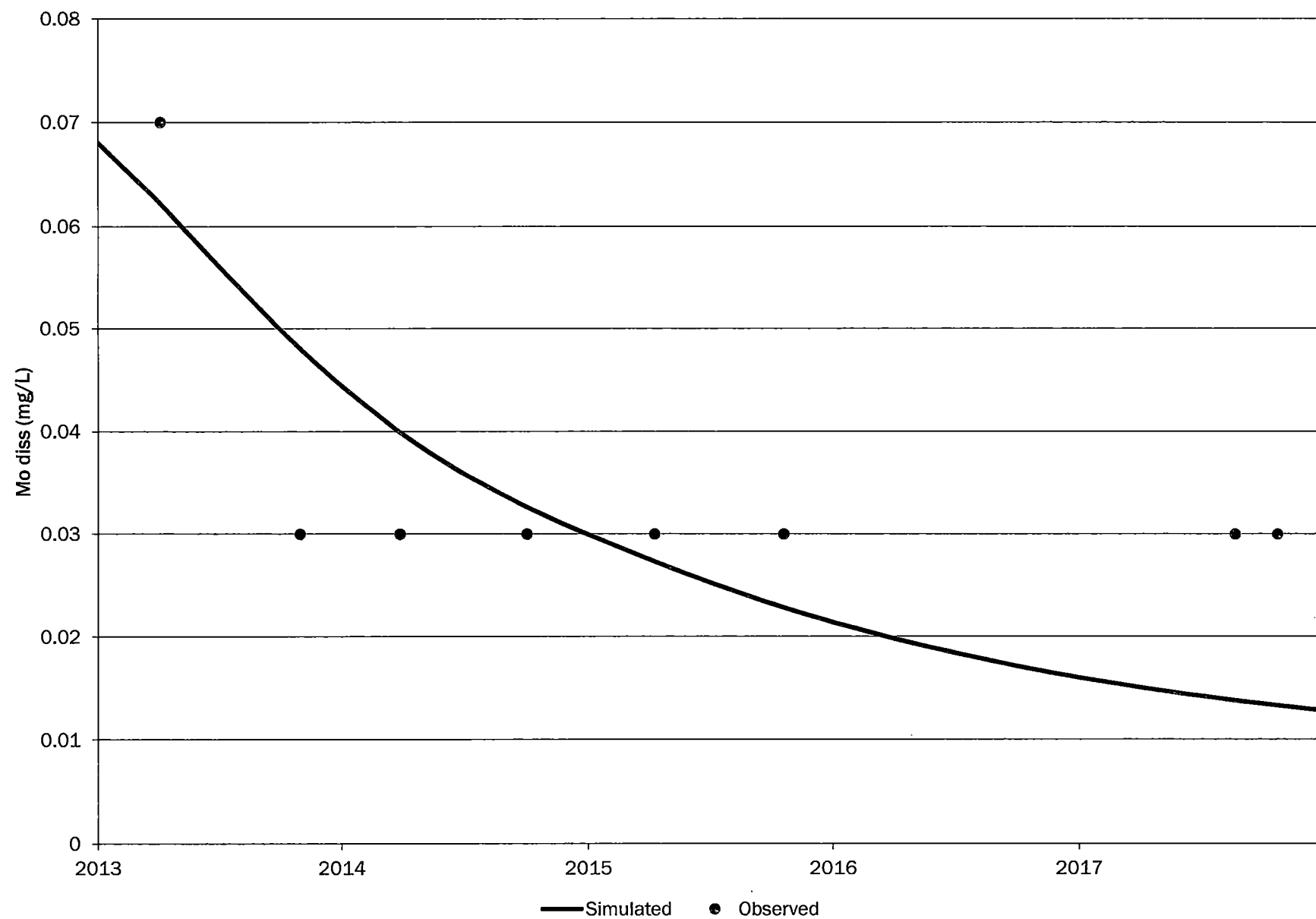
0951R-SA



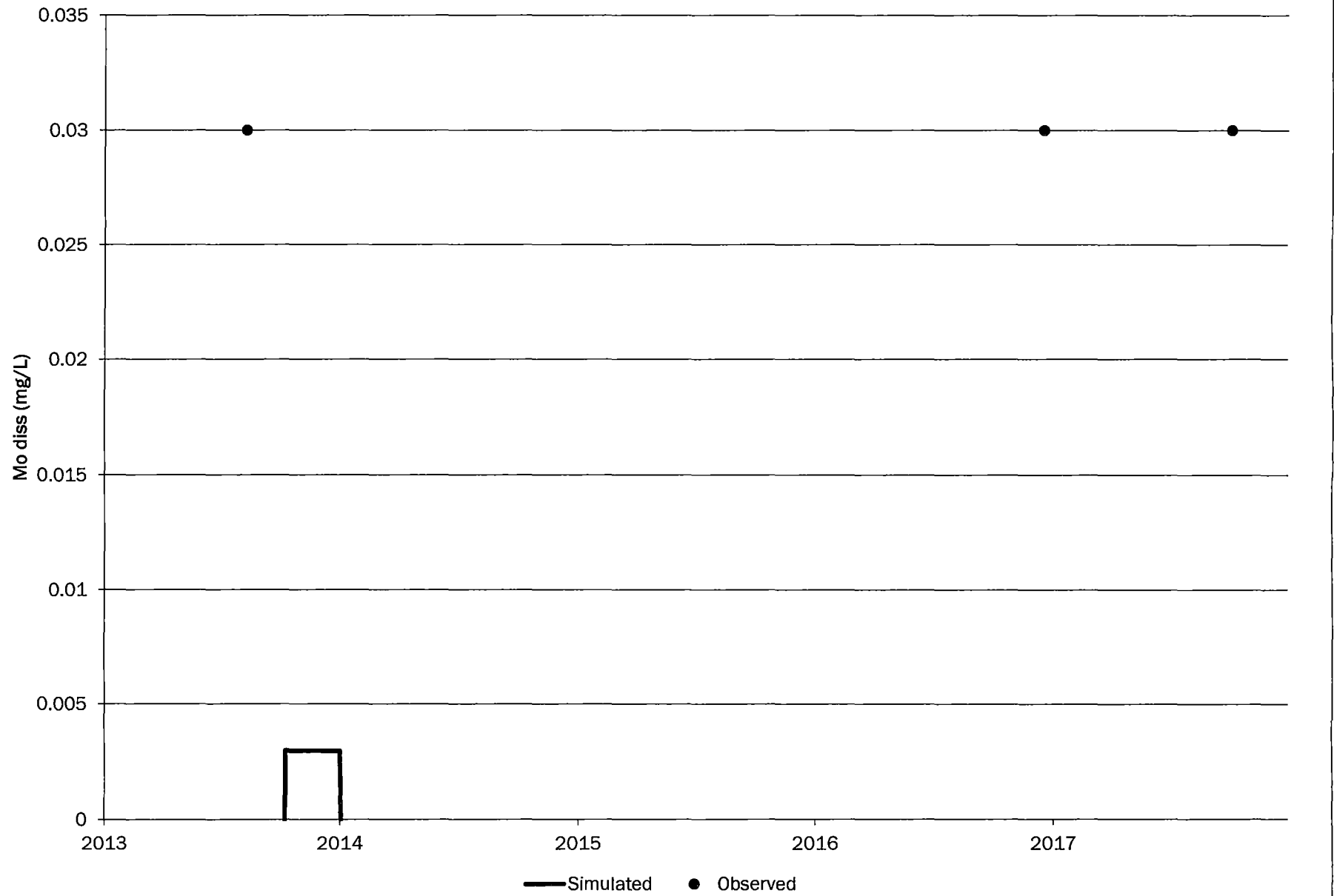
0951-SA



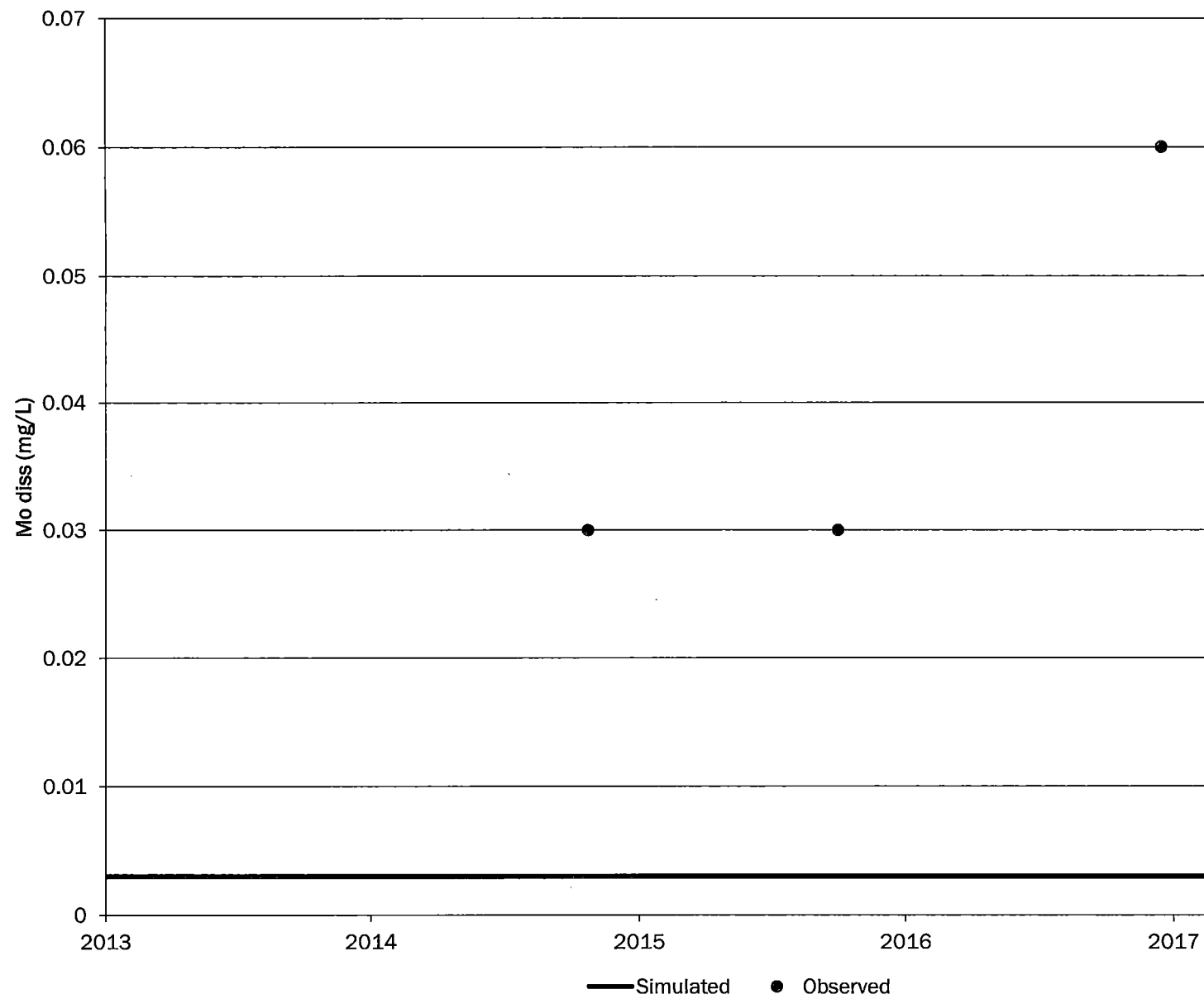
0994-AI



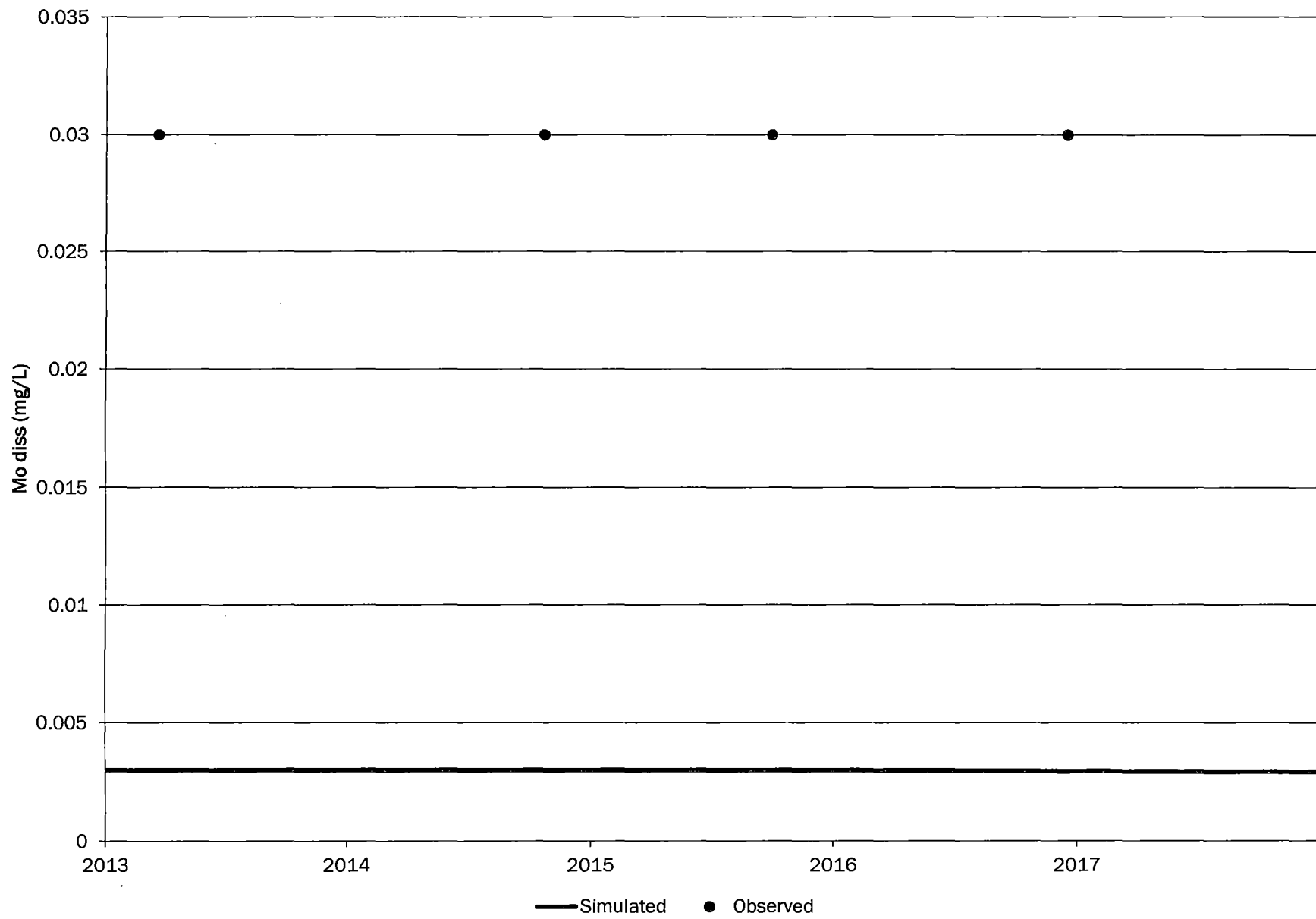
0996-AI



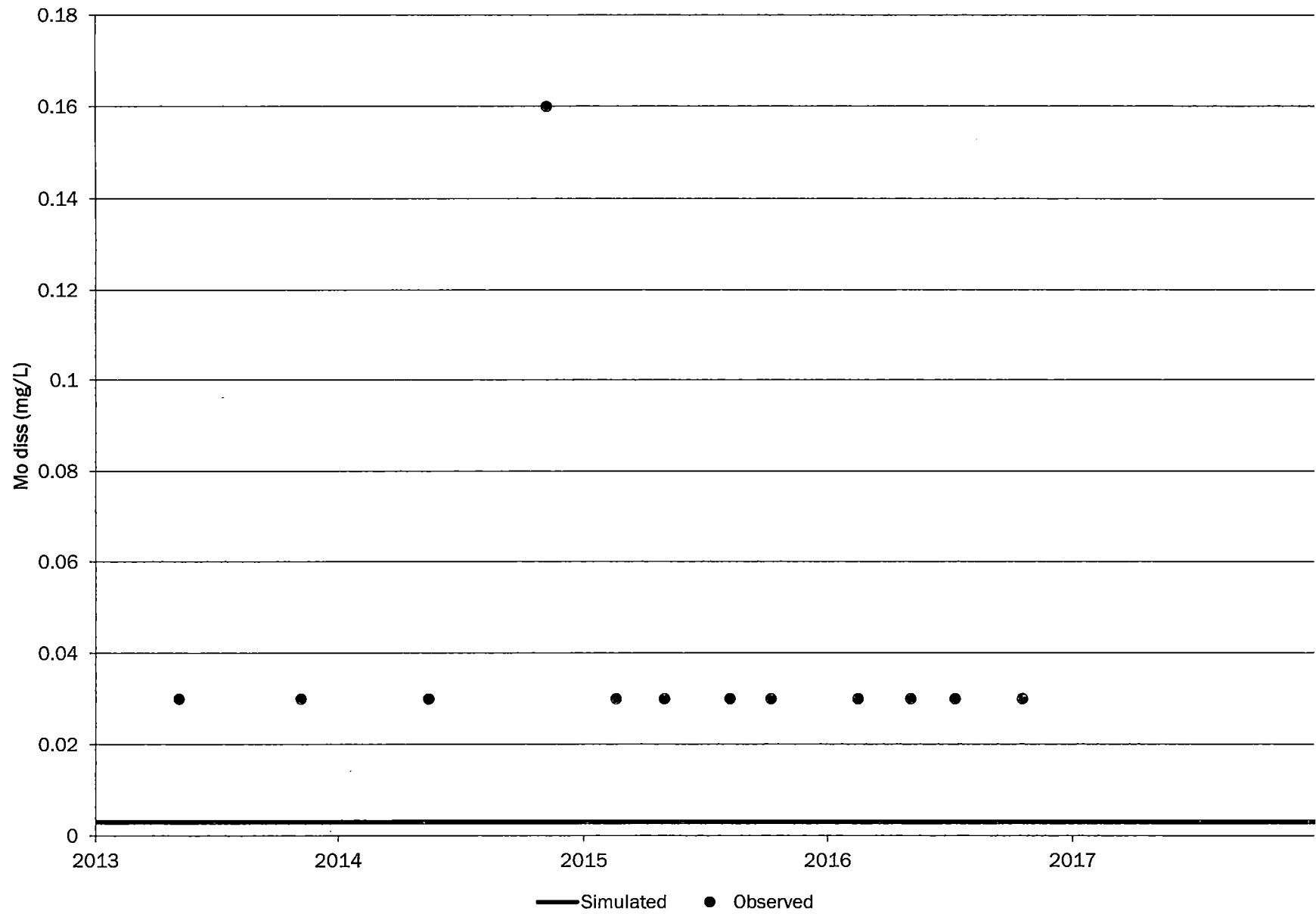
0998-SA



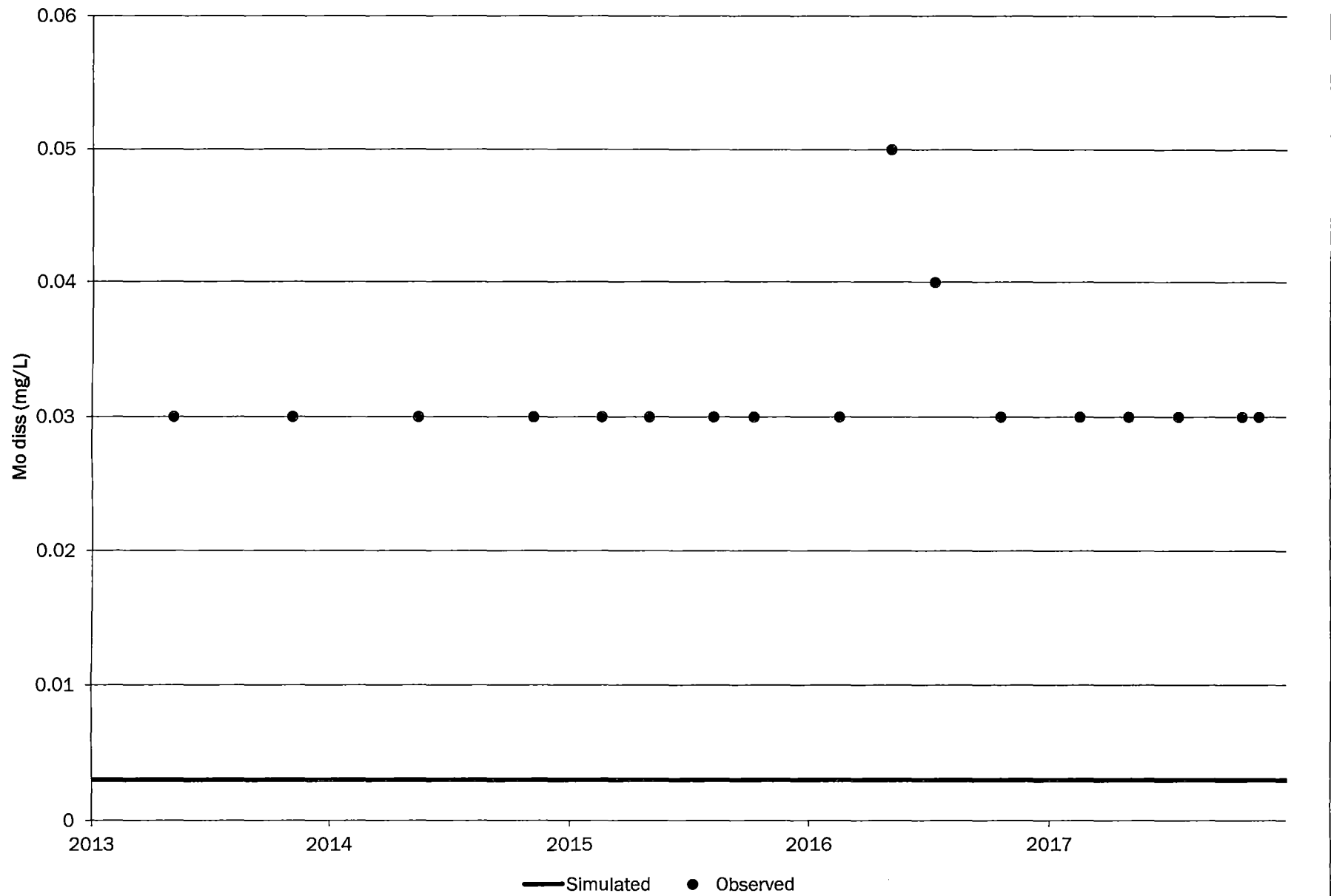
0999-AI



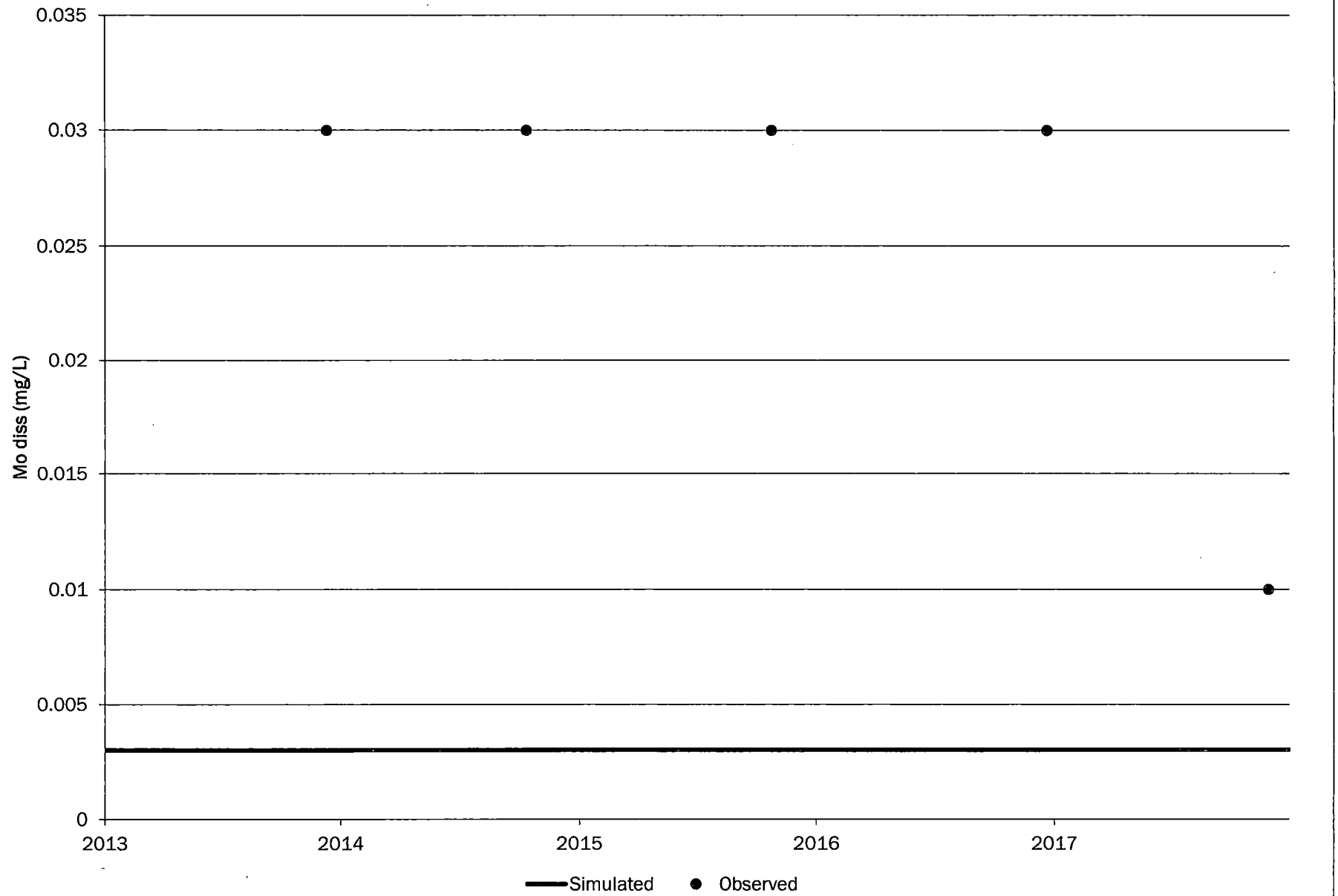
#1 Deepwell-SA



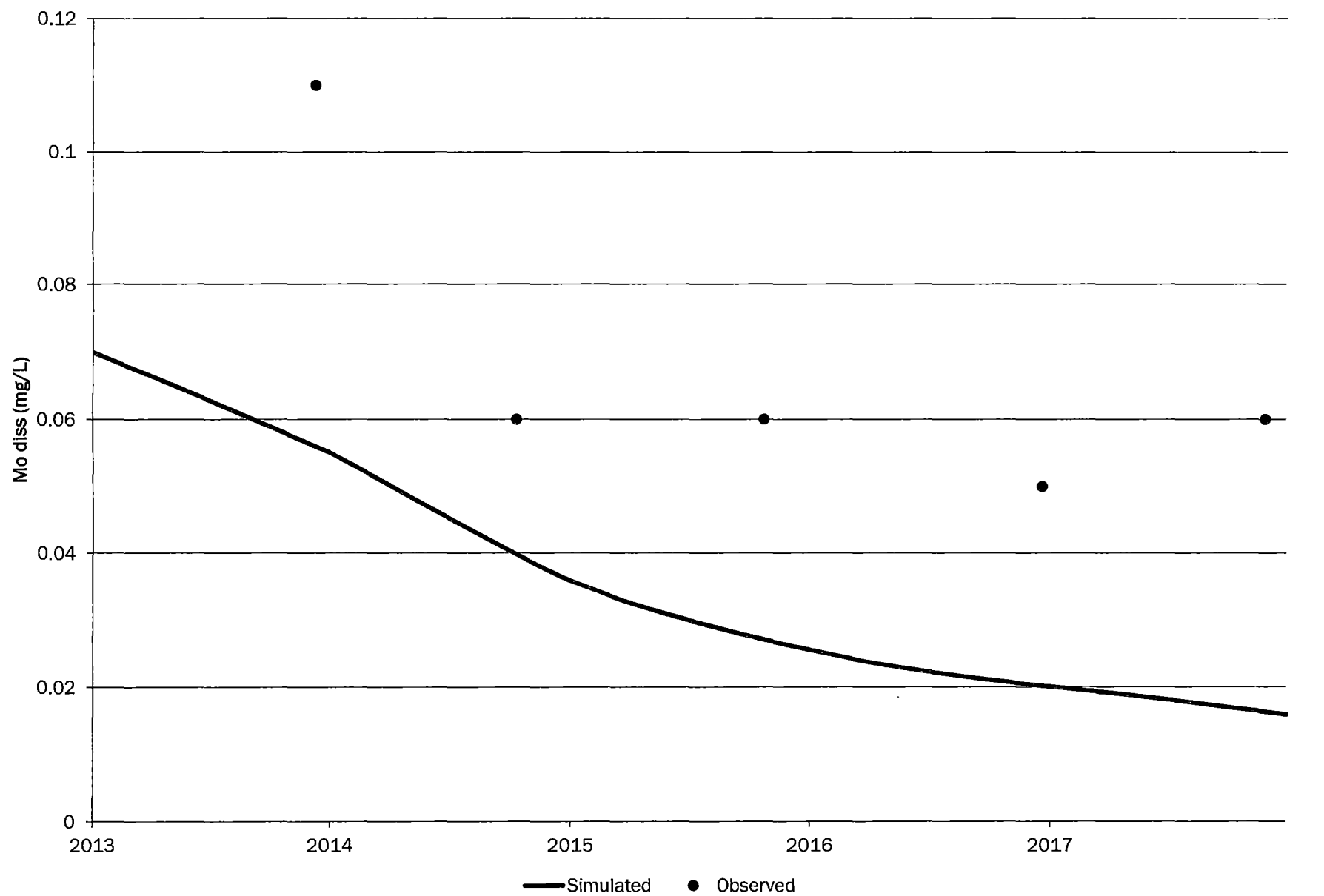
#2 Deepwell-SA



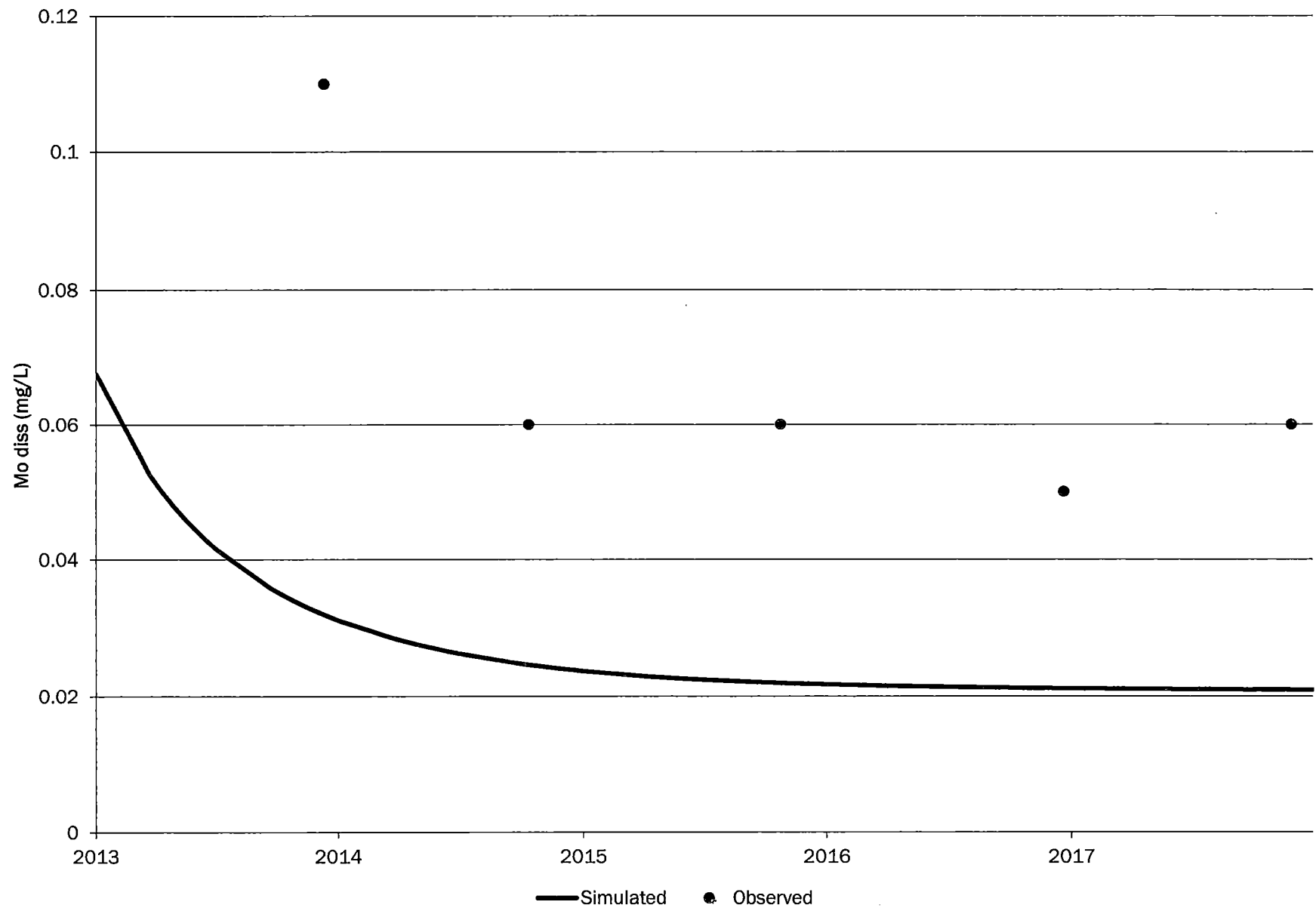
ACW-MC



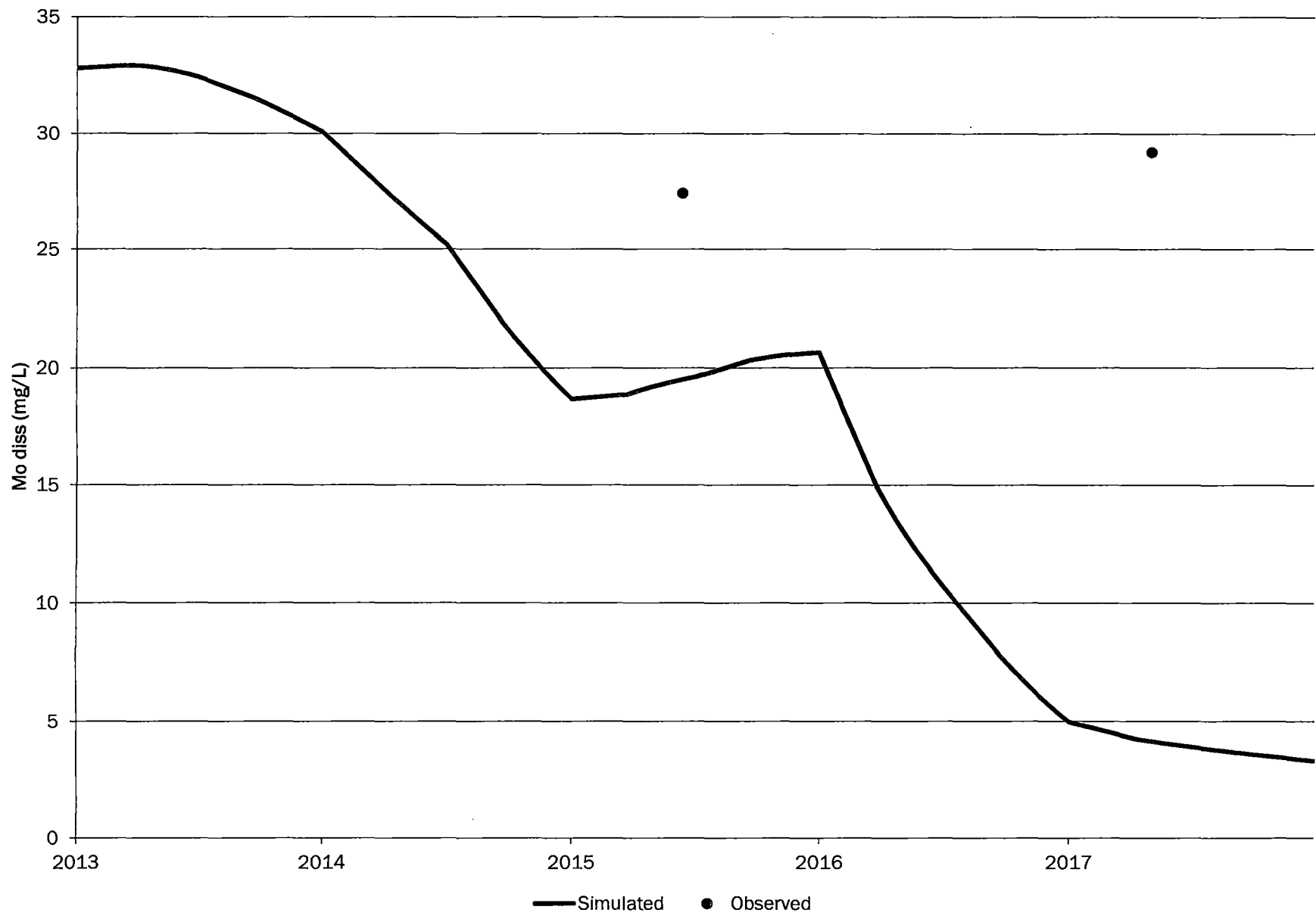
AW-AI



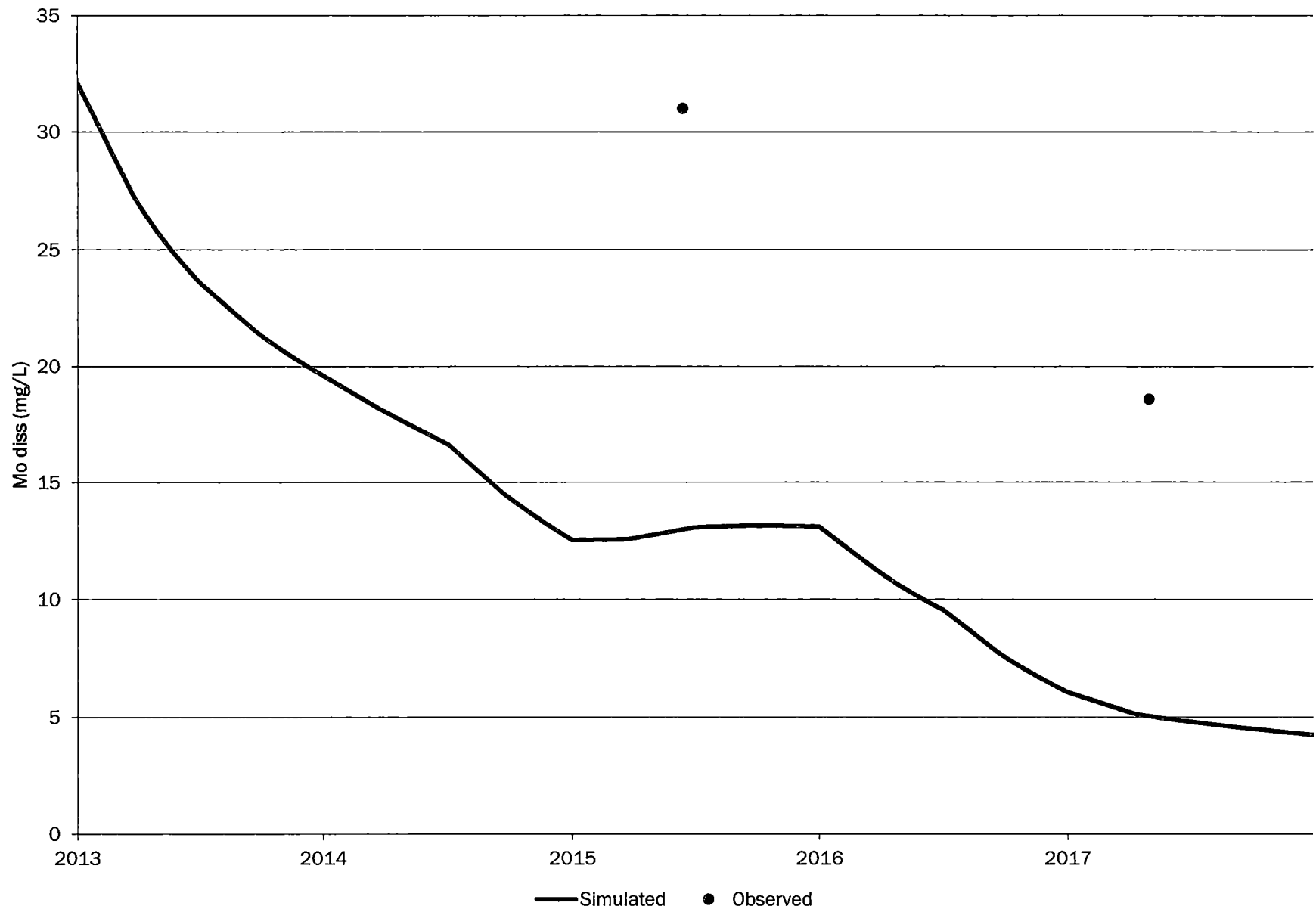
AW-UC



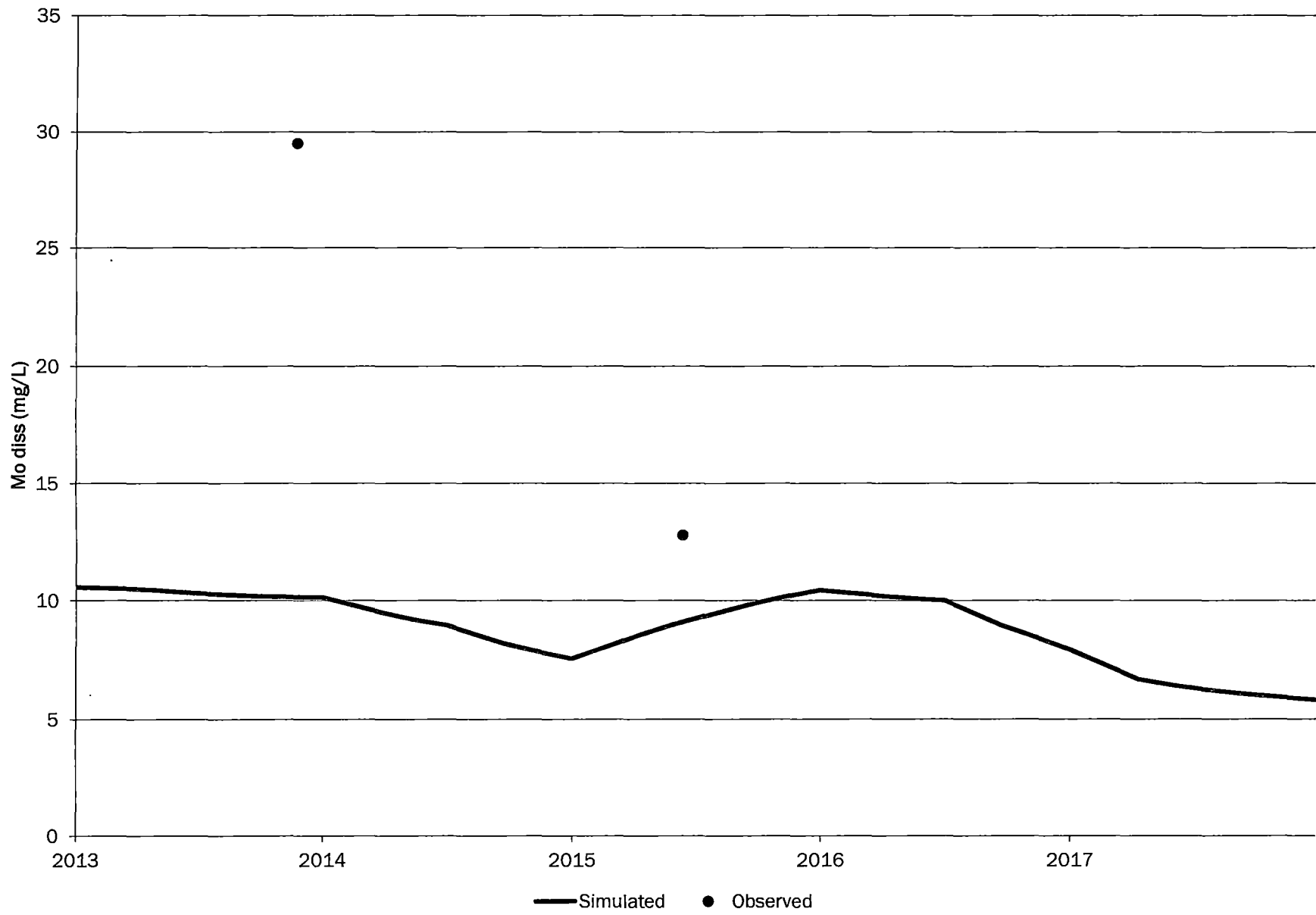
B4-AI



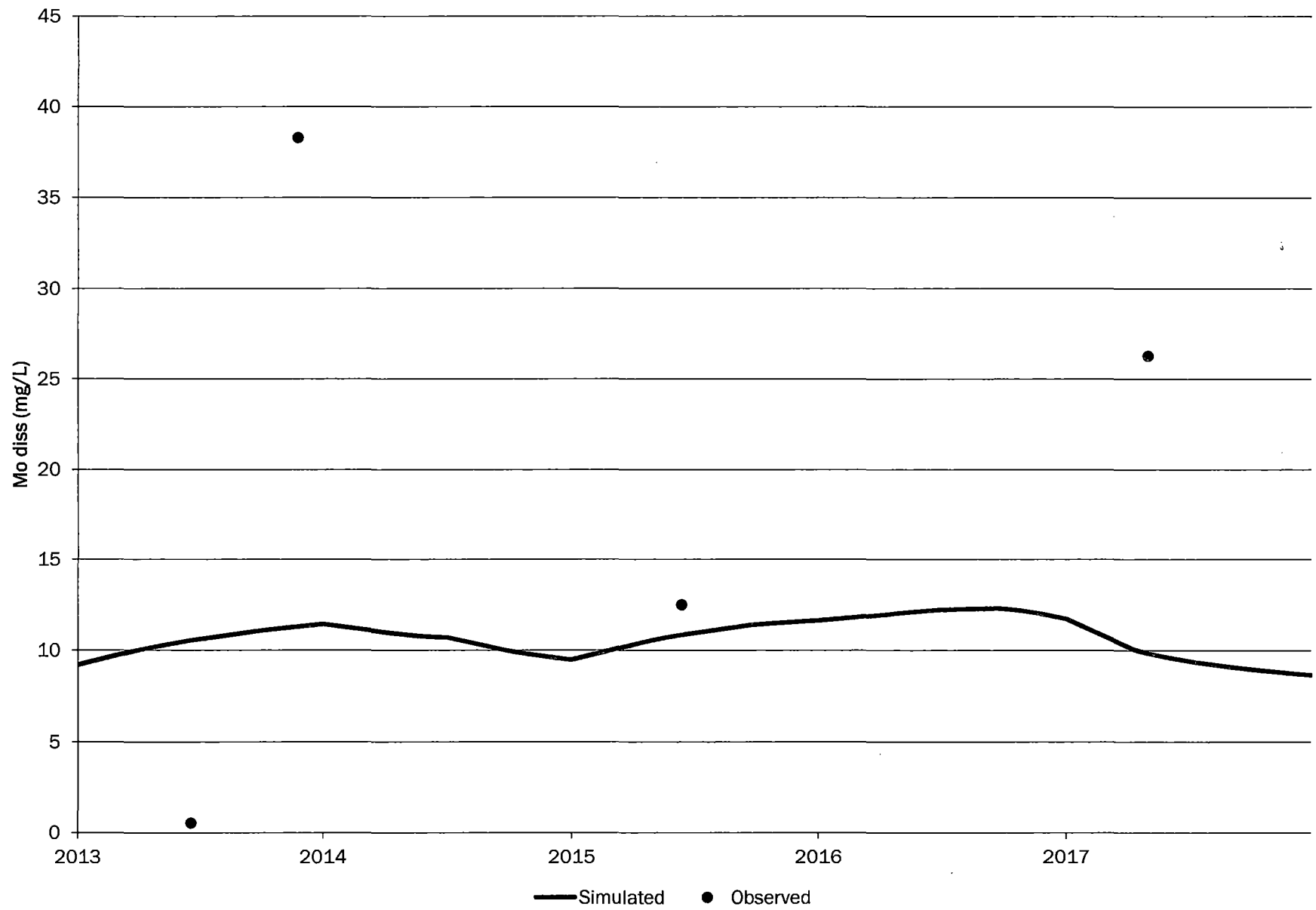
B5-AI



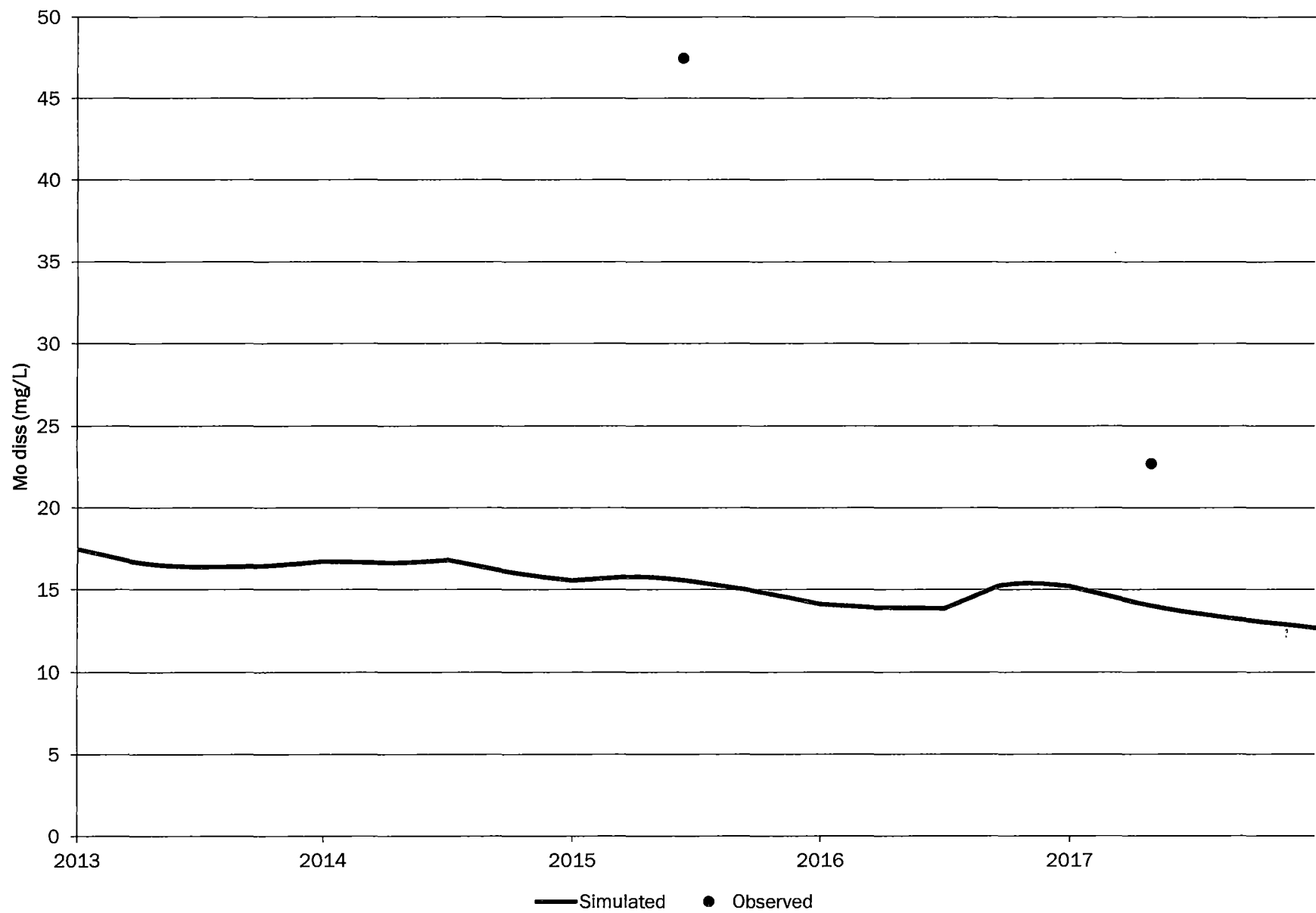
B6-AI

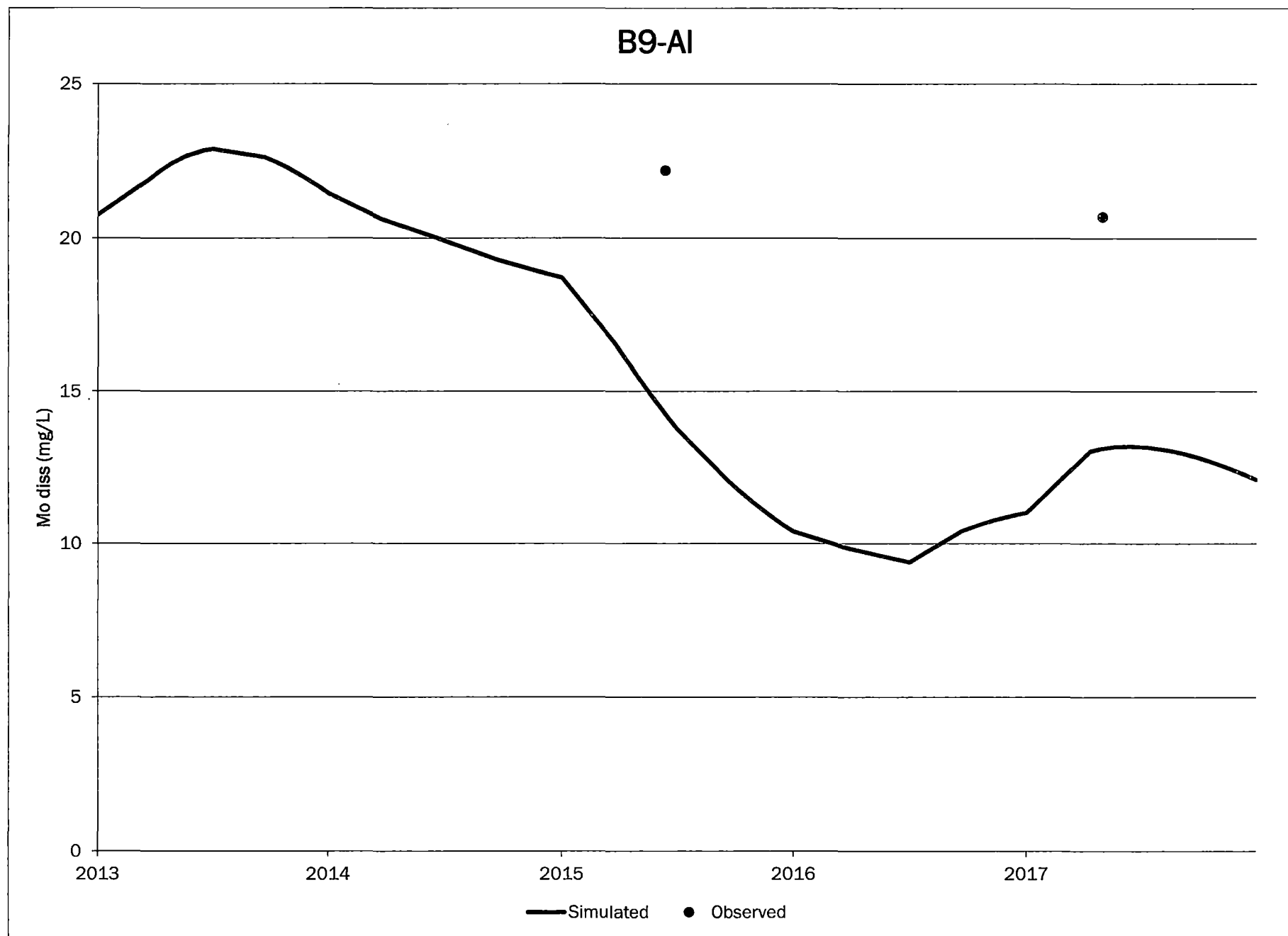


B7-AI

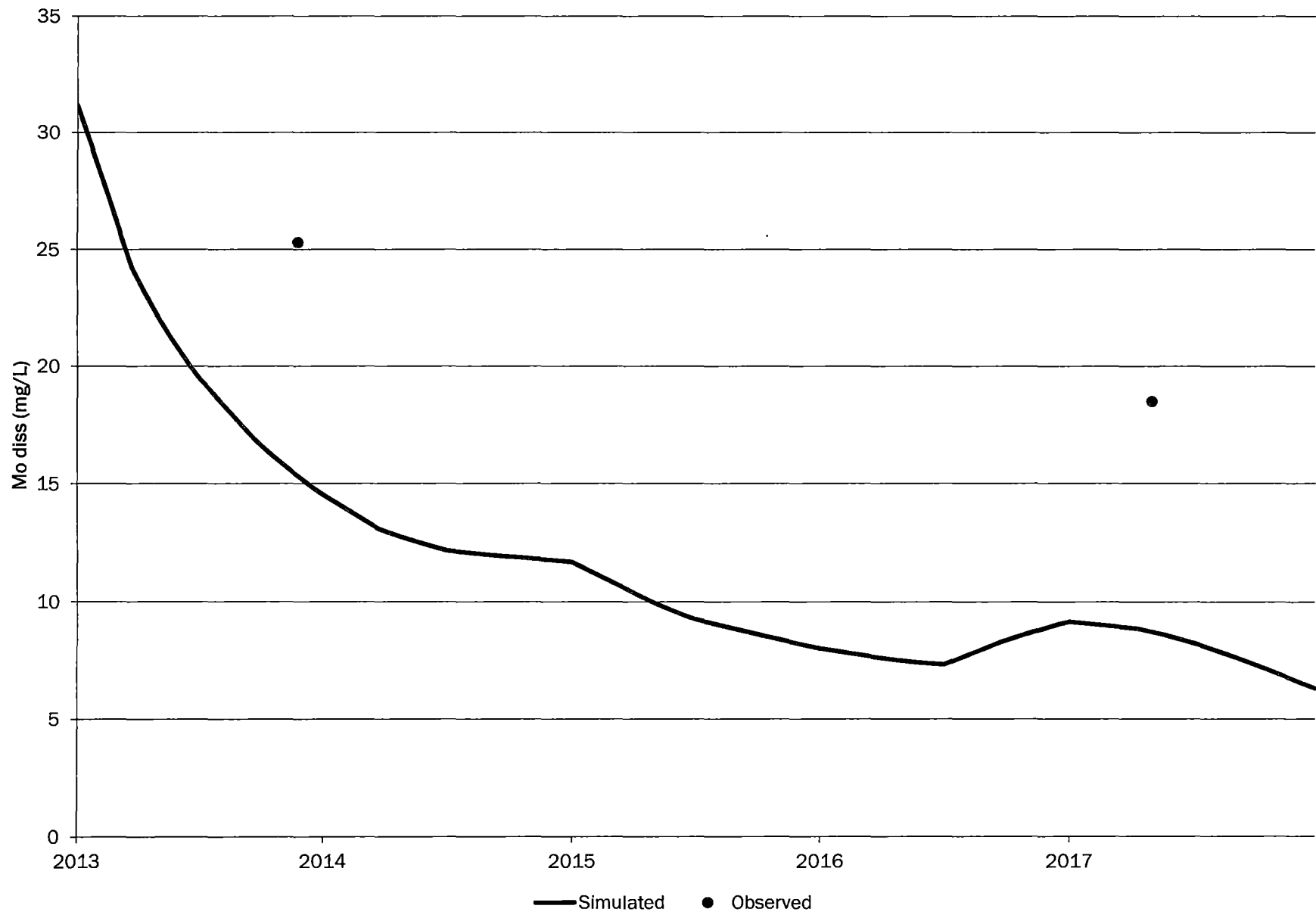


B8-AI

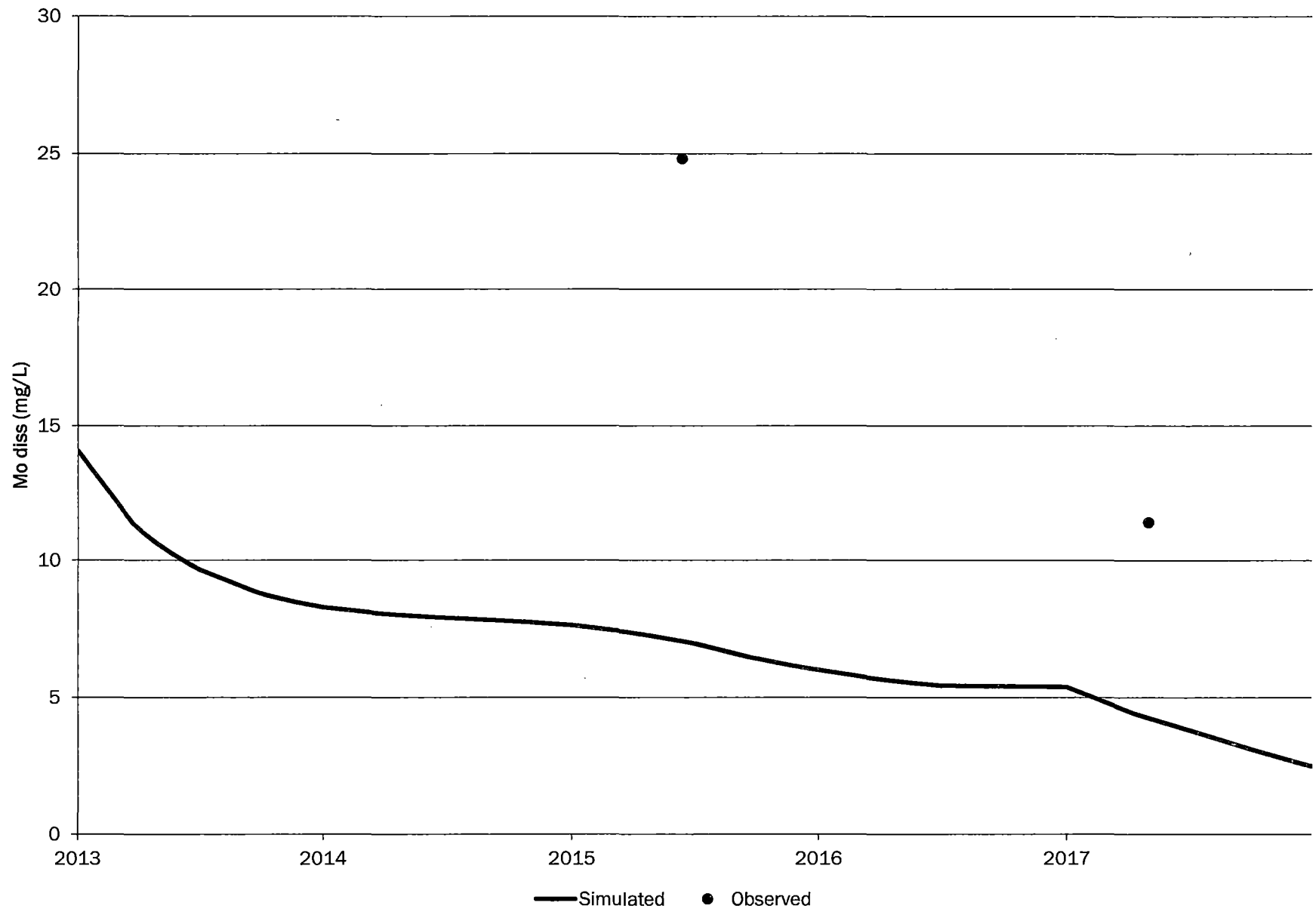




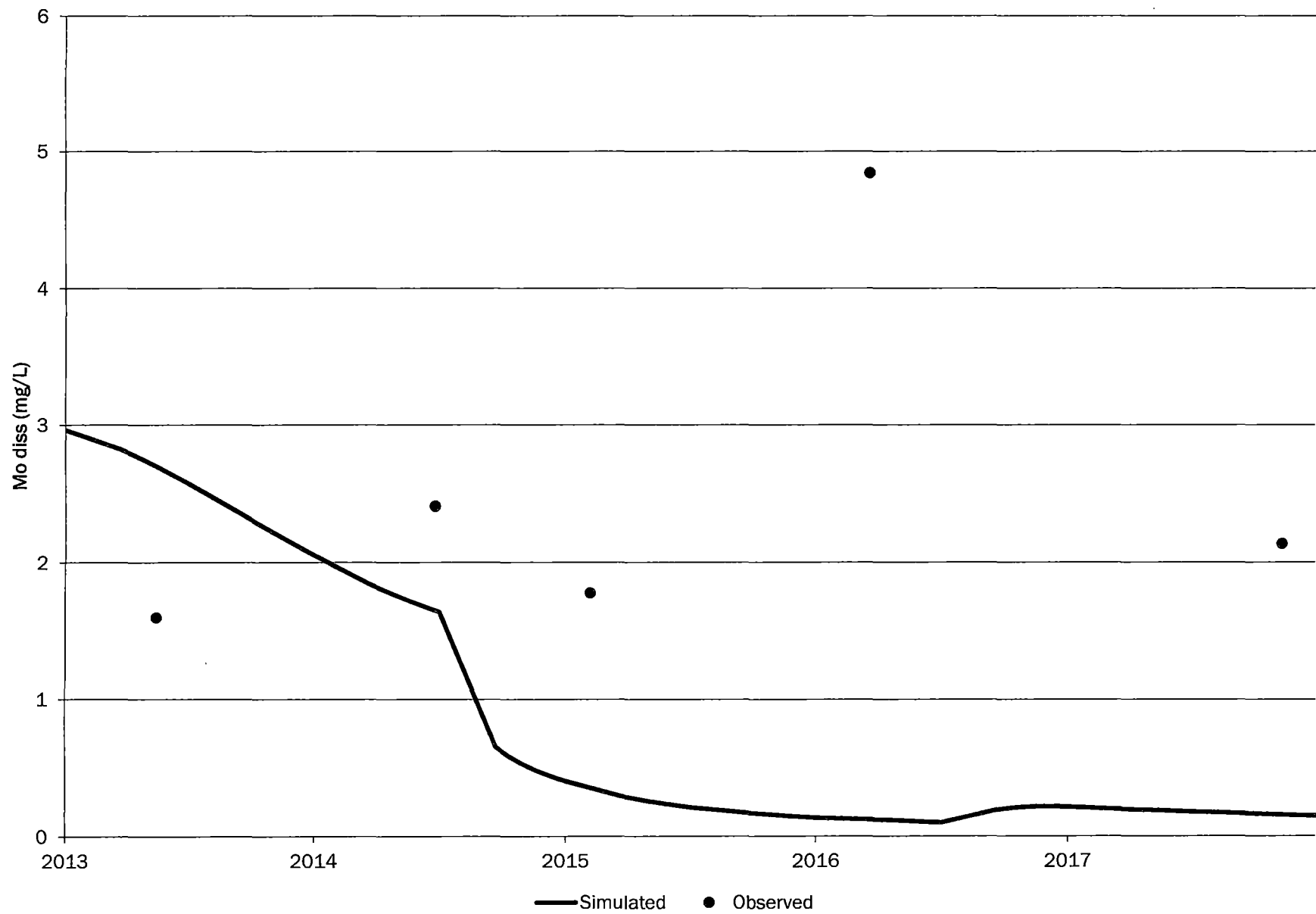
B10-AI



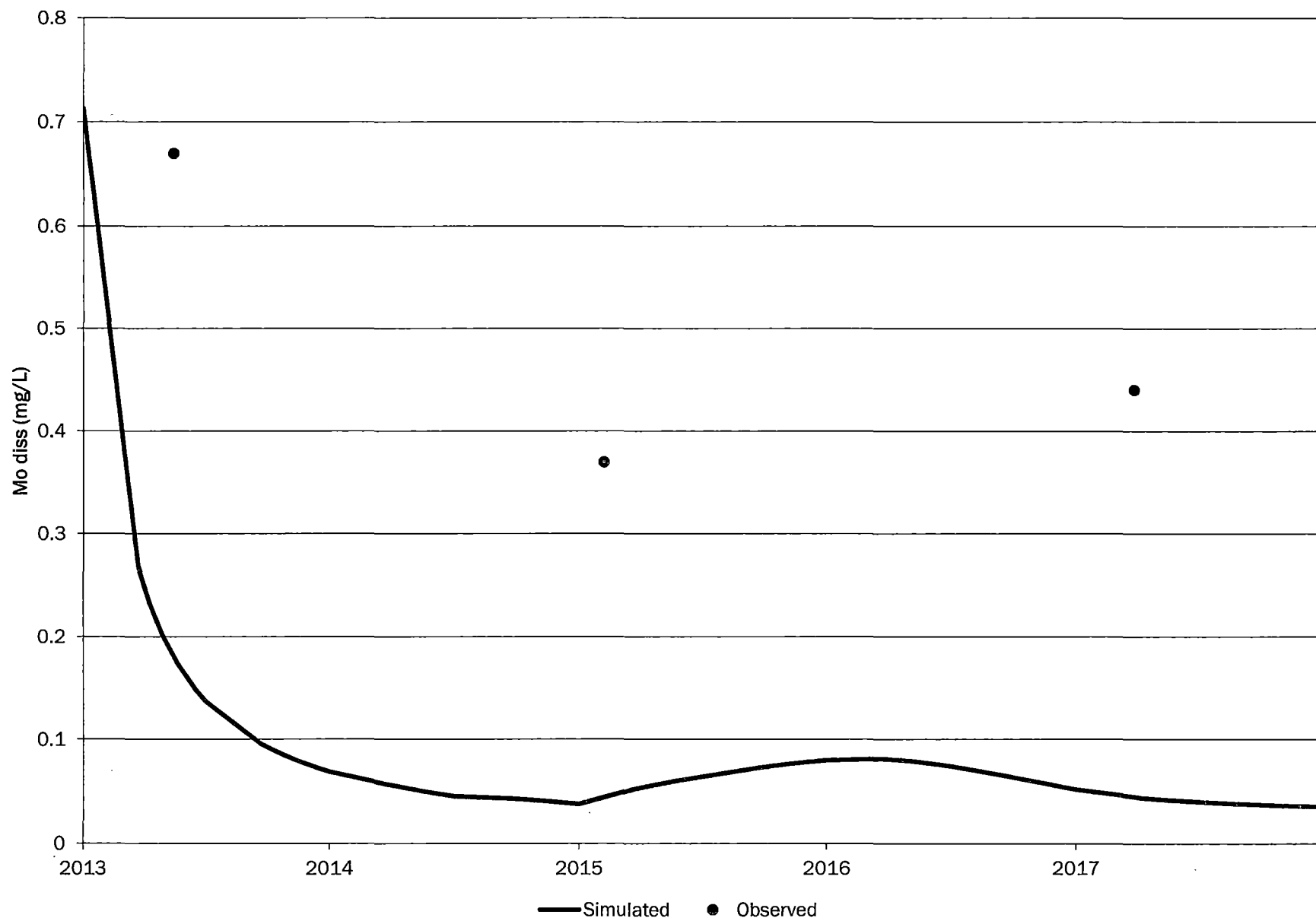
B11-AI



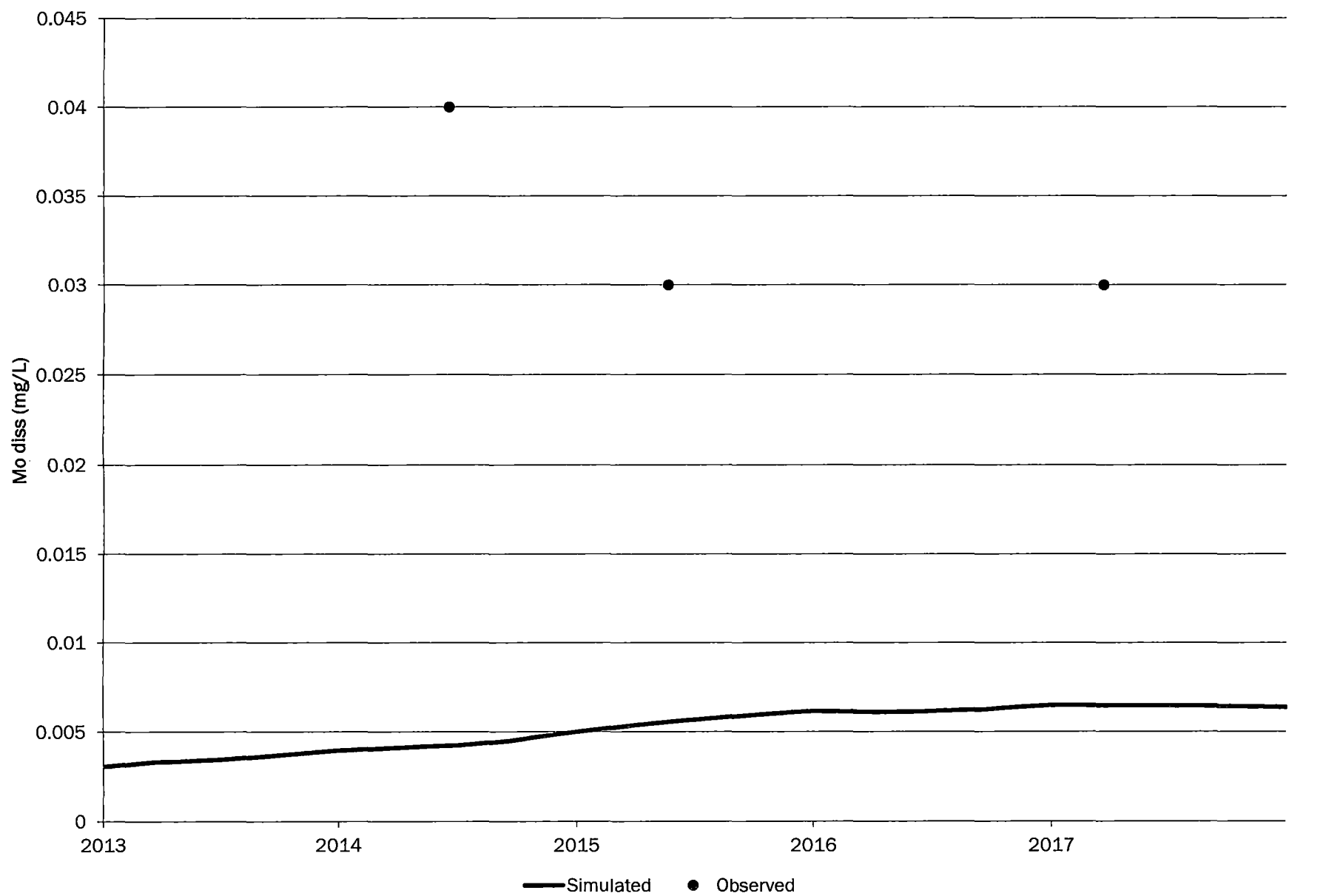
B12-AI



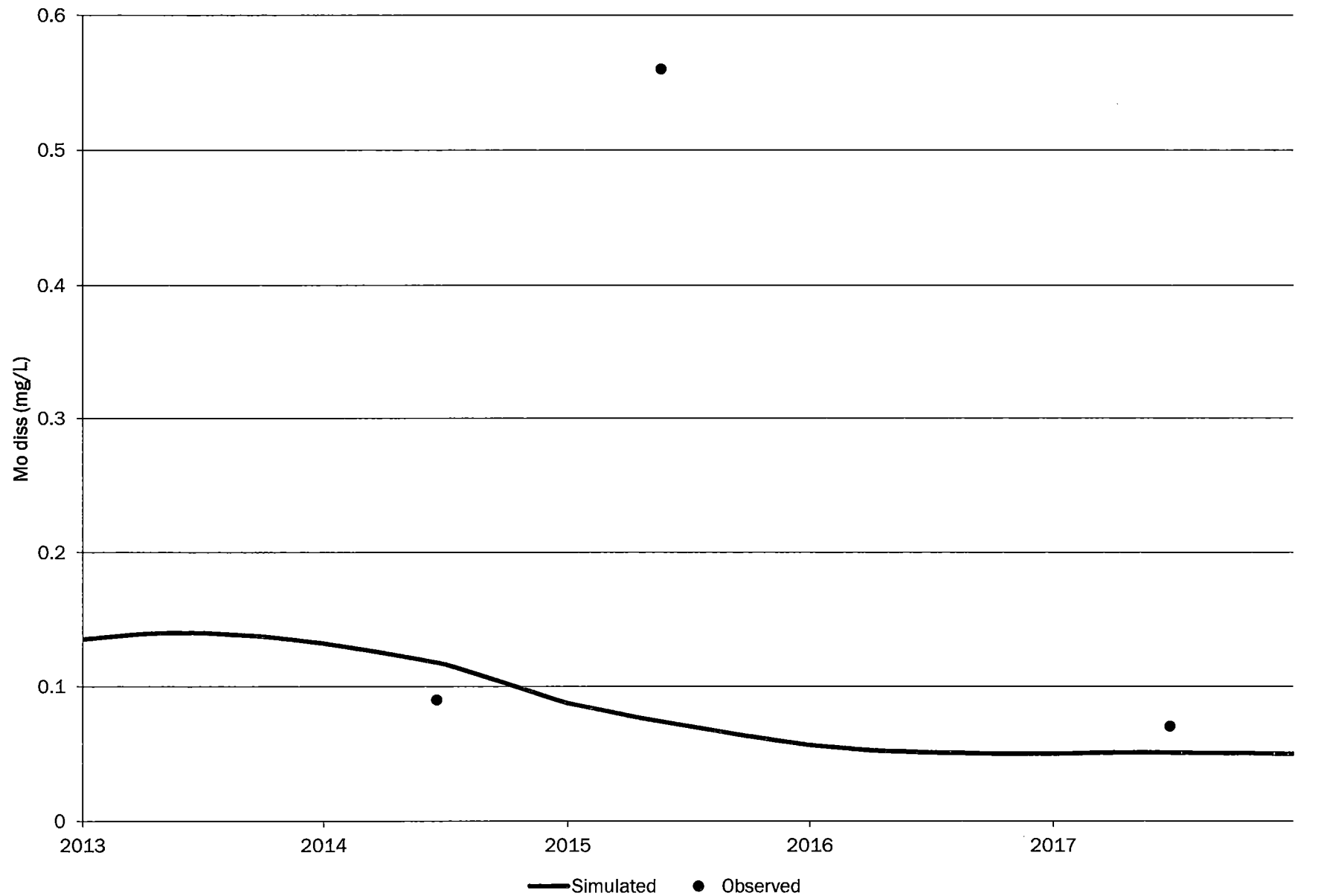
B13-AI



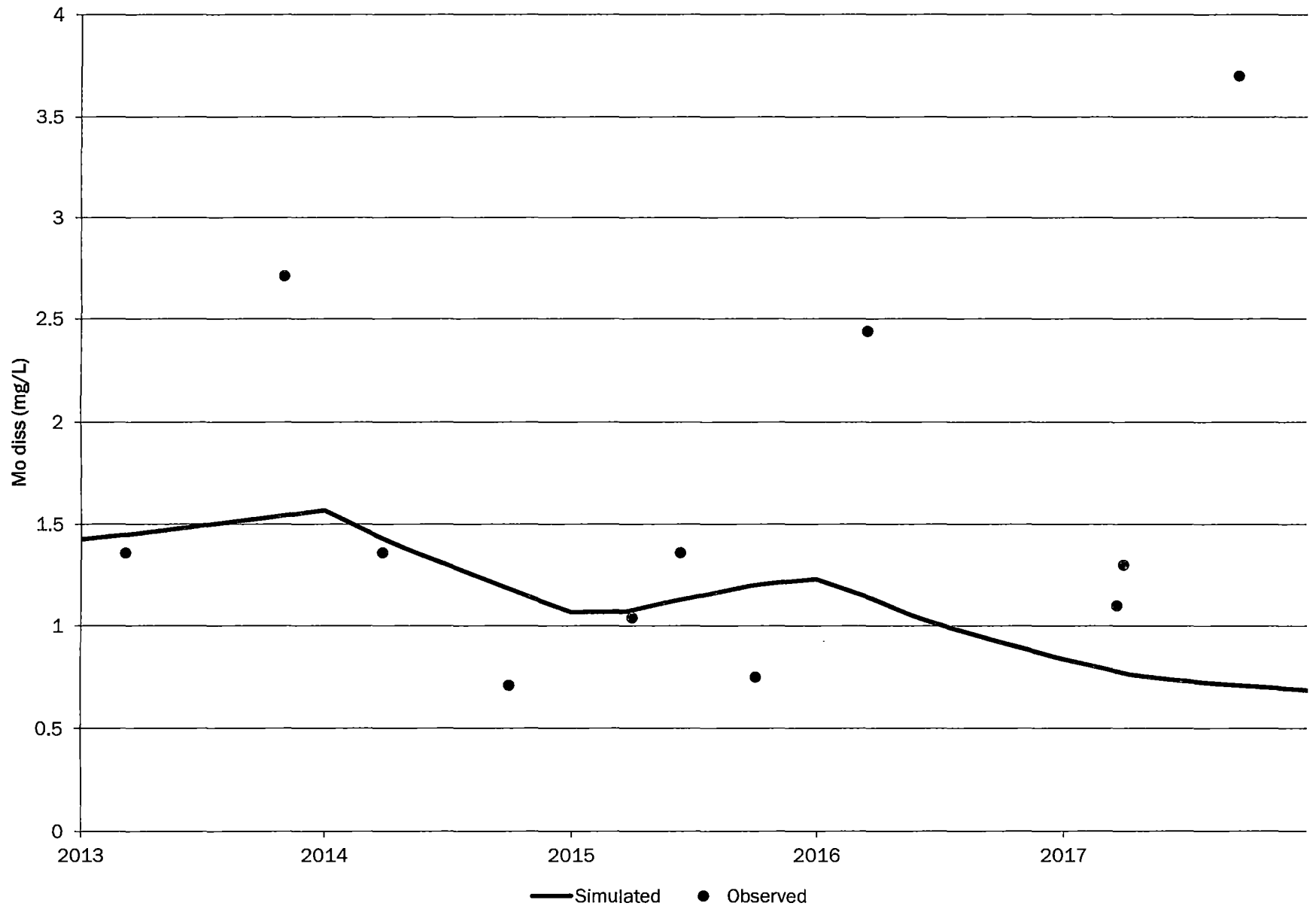
B-AI



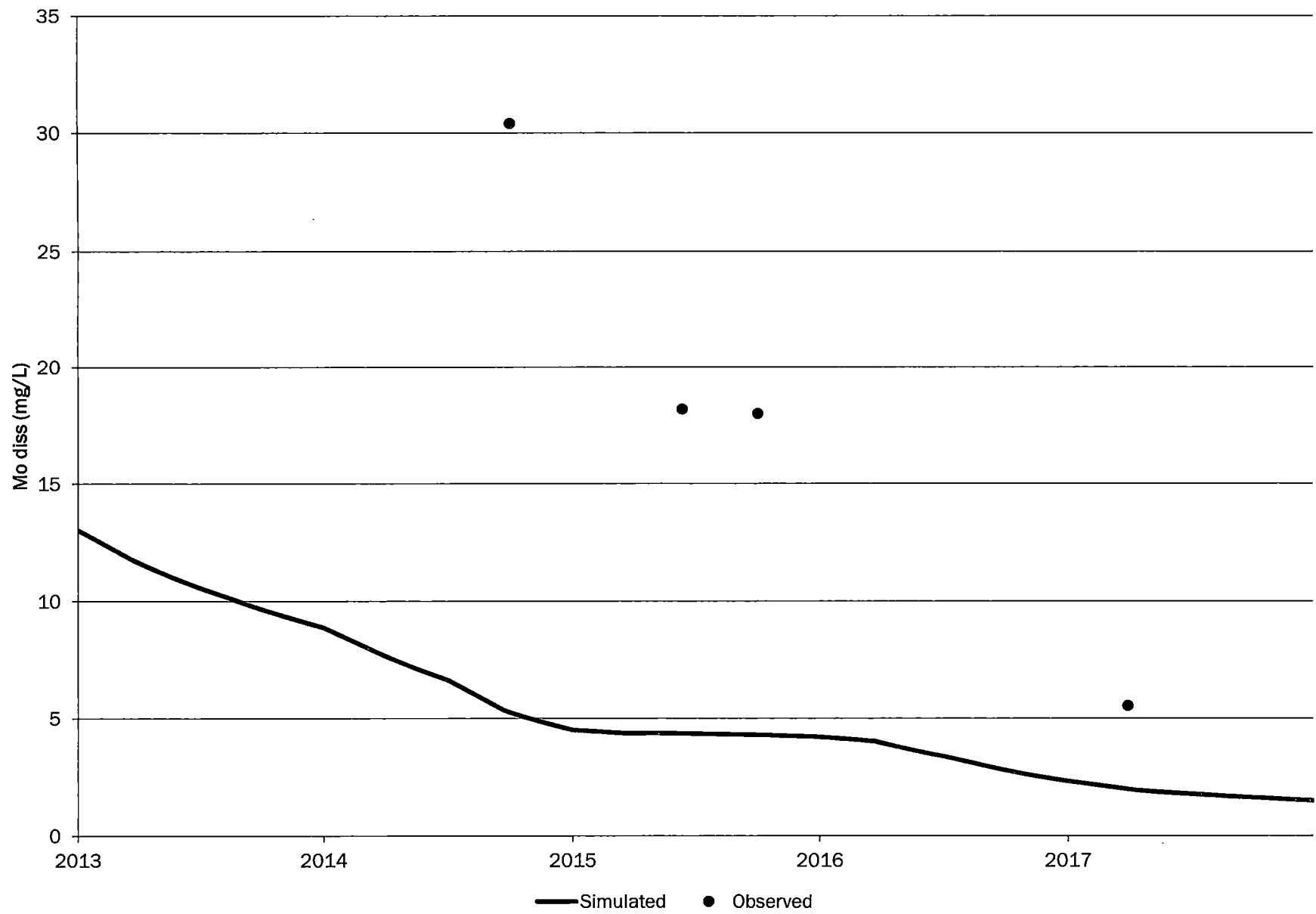
BC-AI



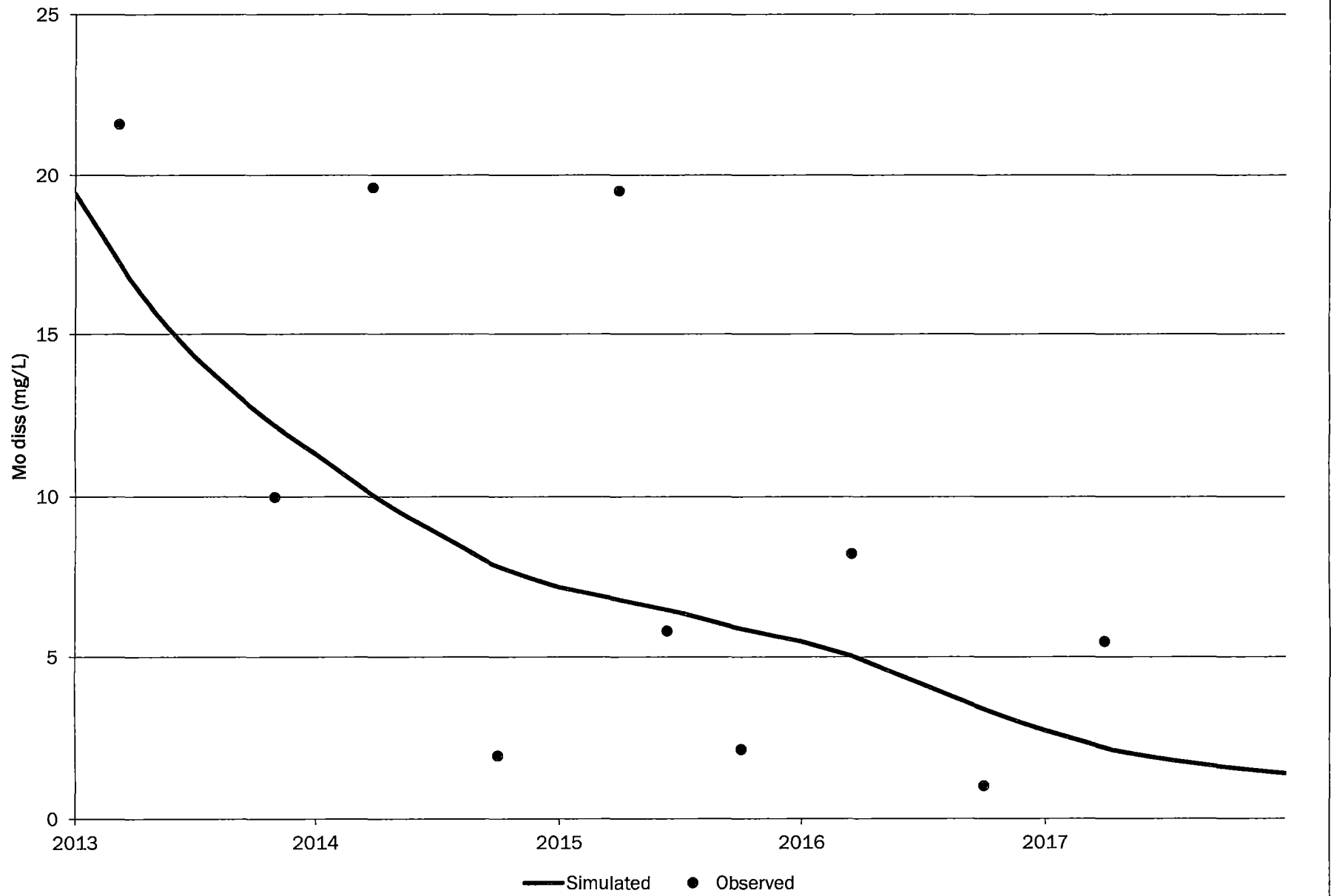
C6-AI



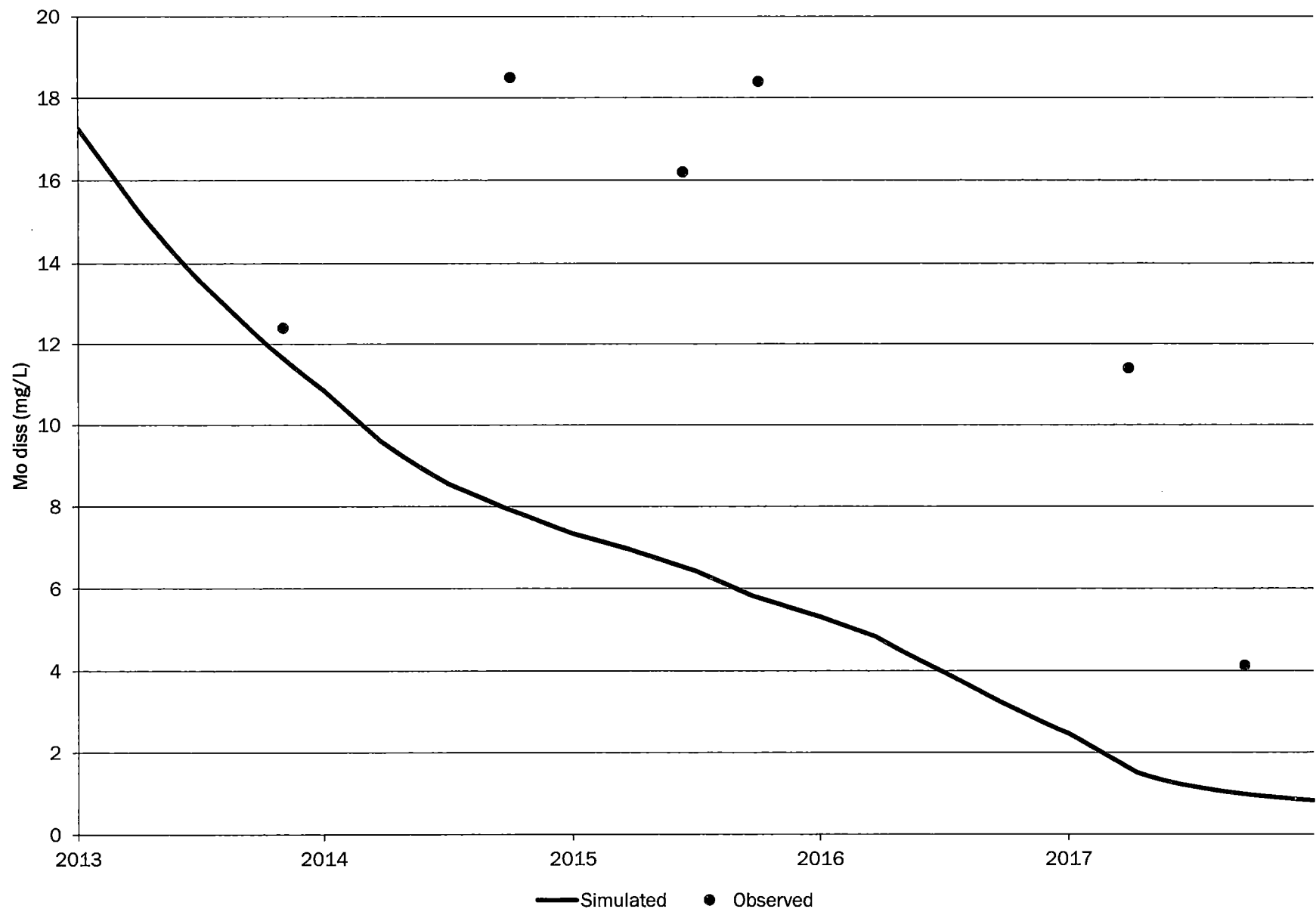
C7-AI



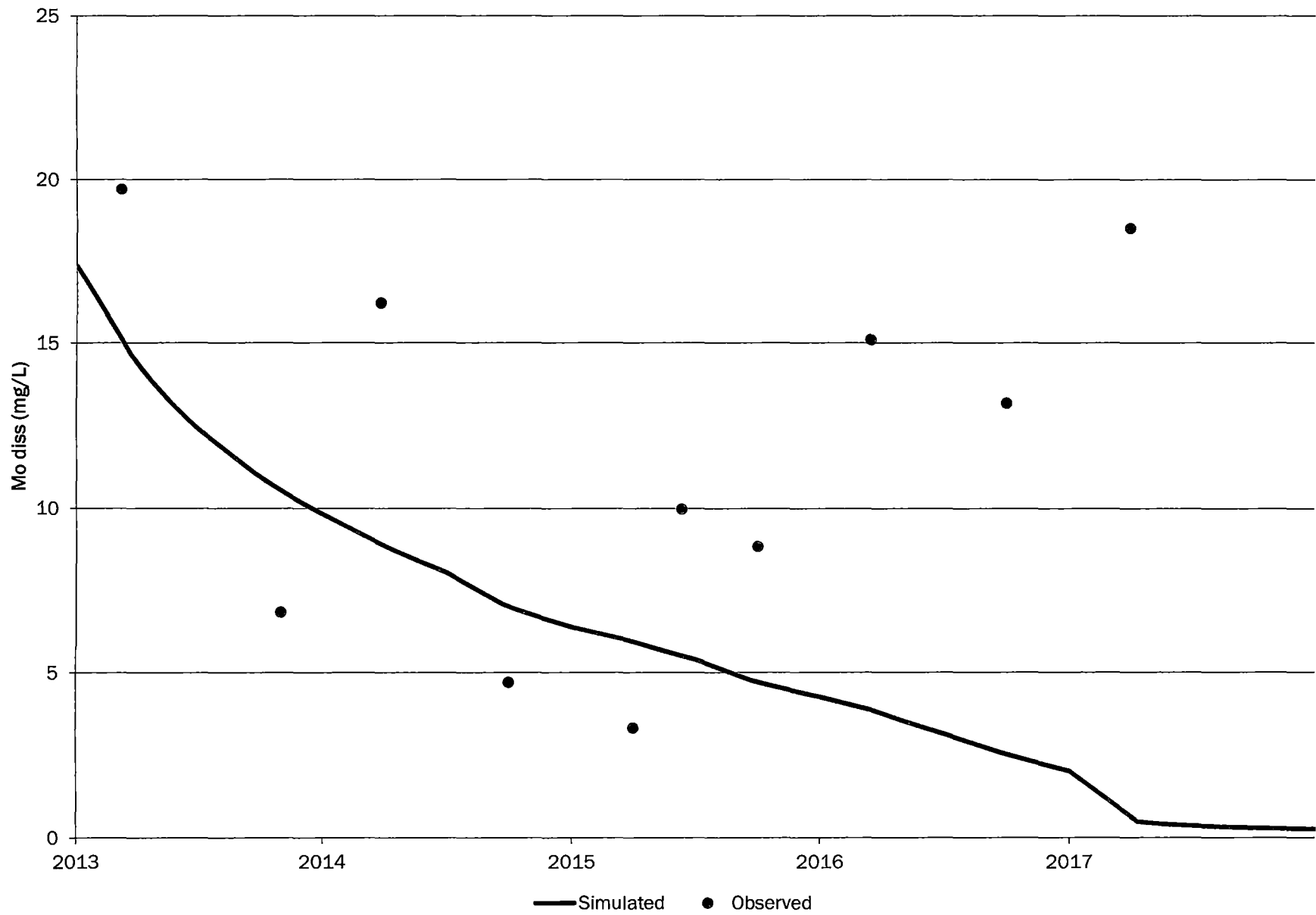
C8-AI



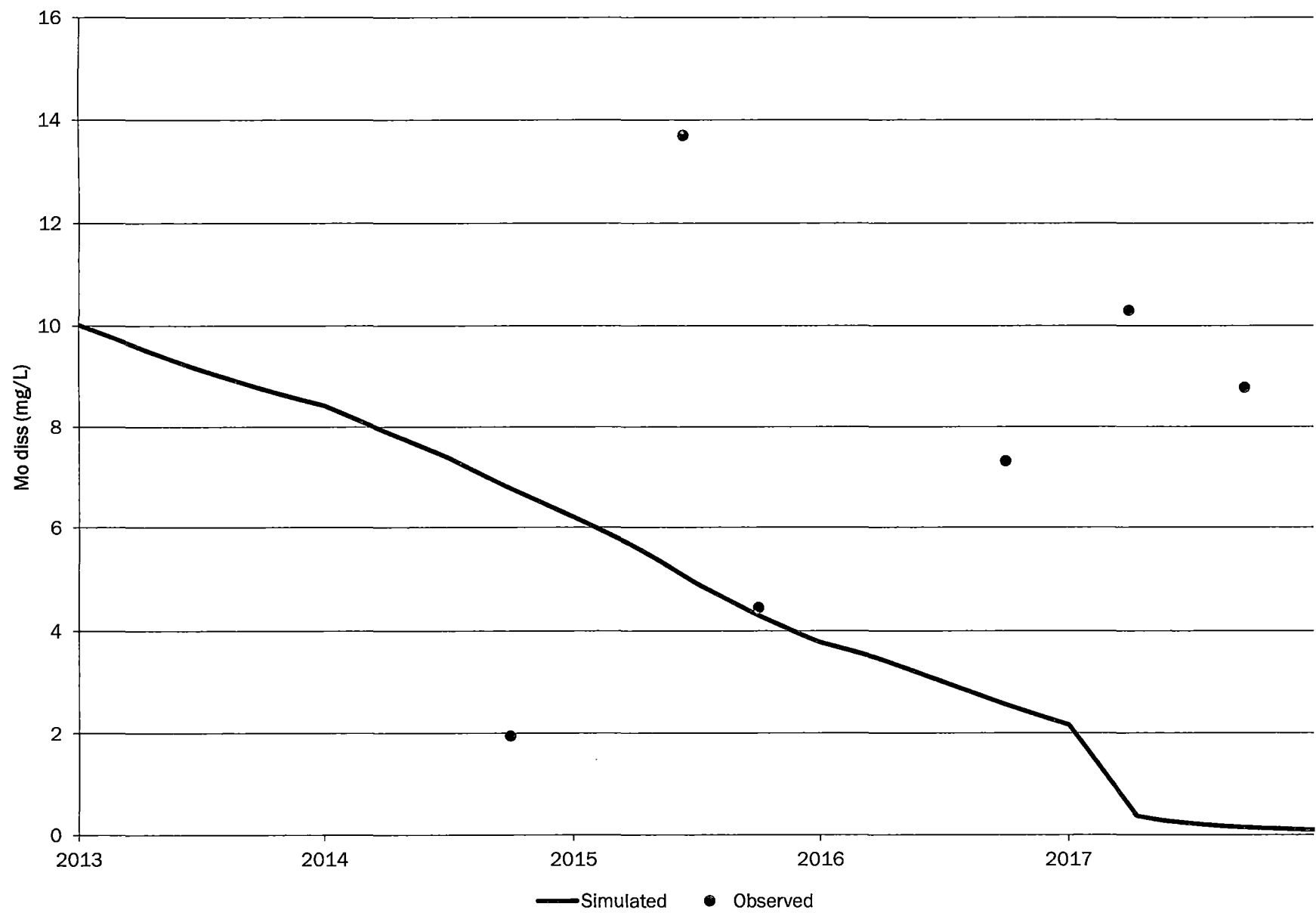
C9-AI



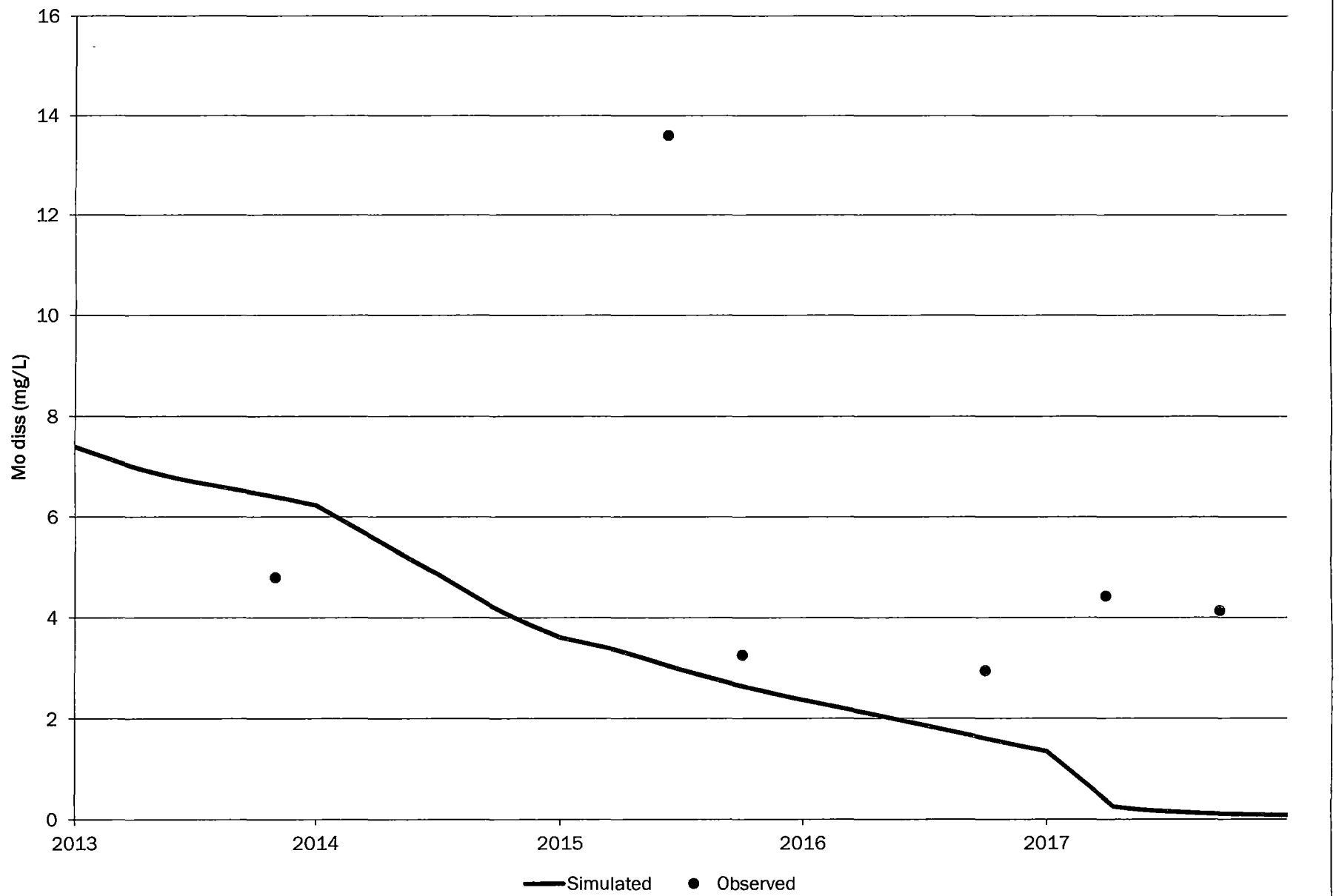
C10-AI



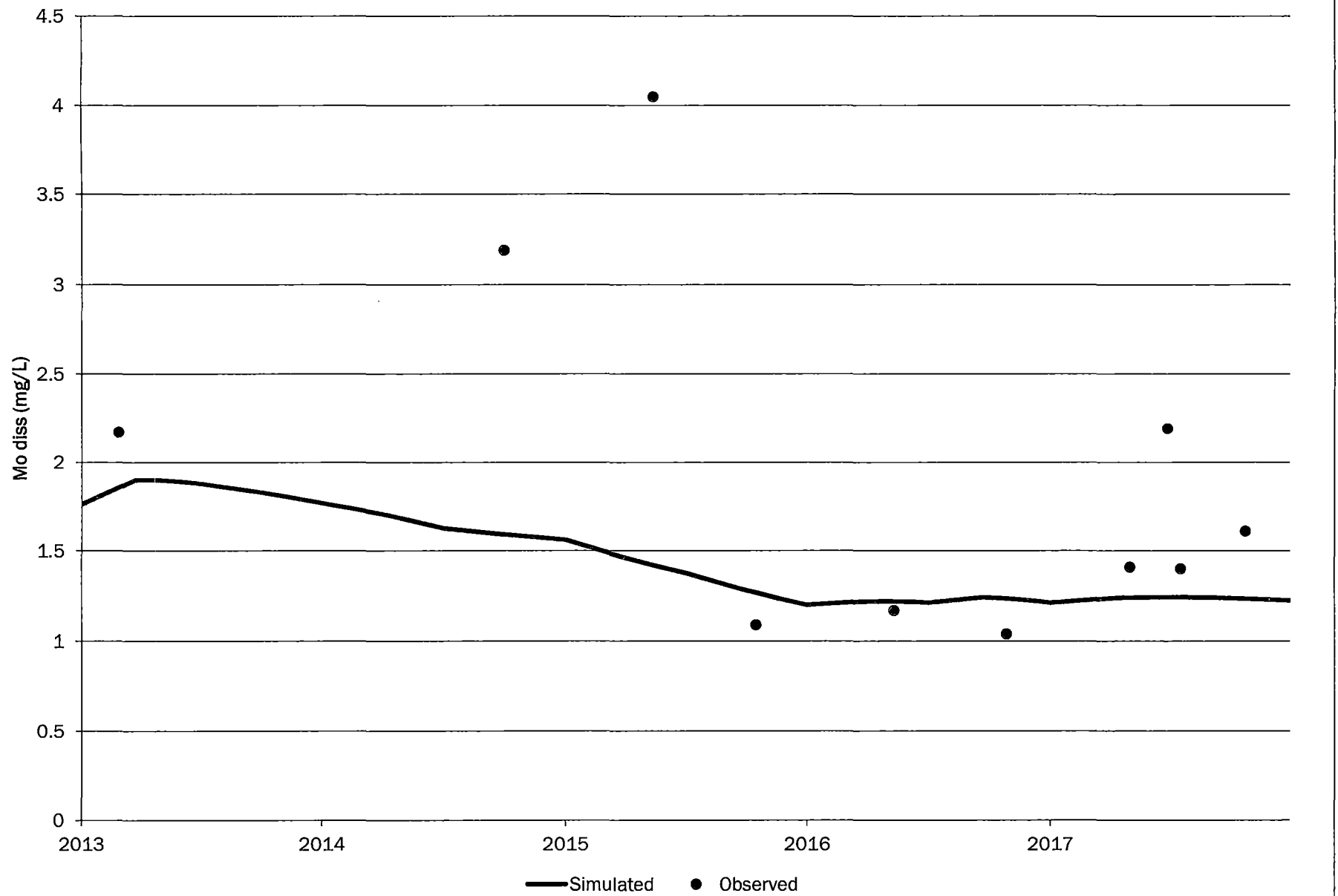
C11-AI



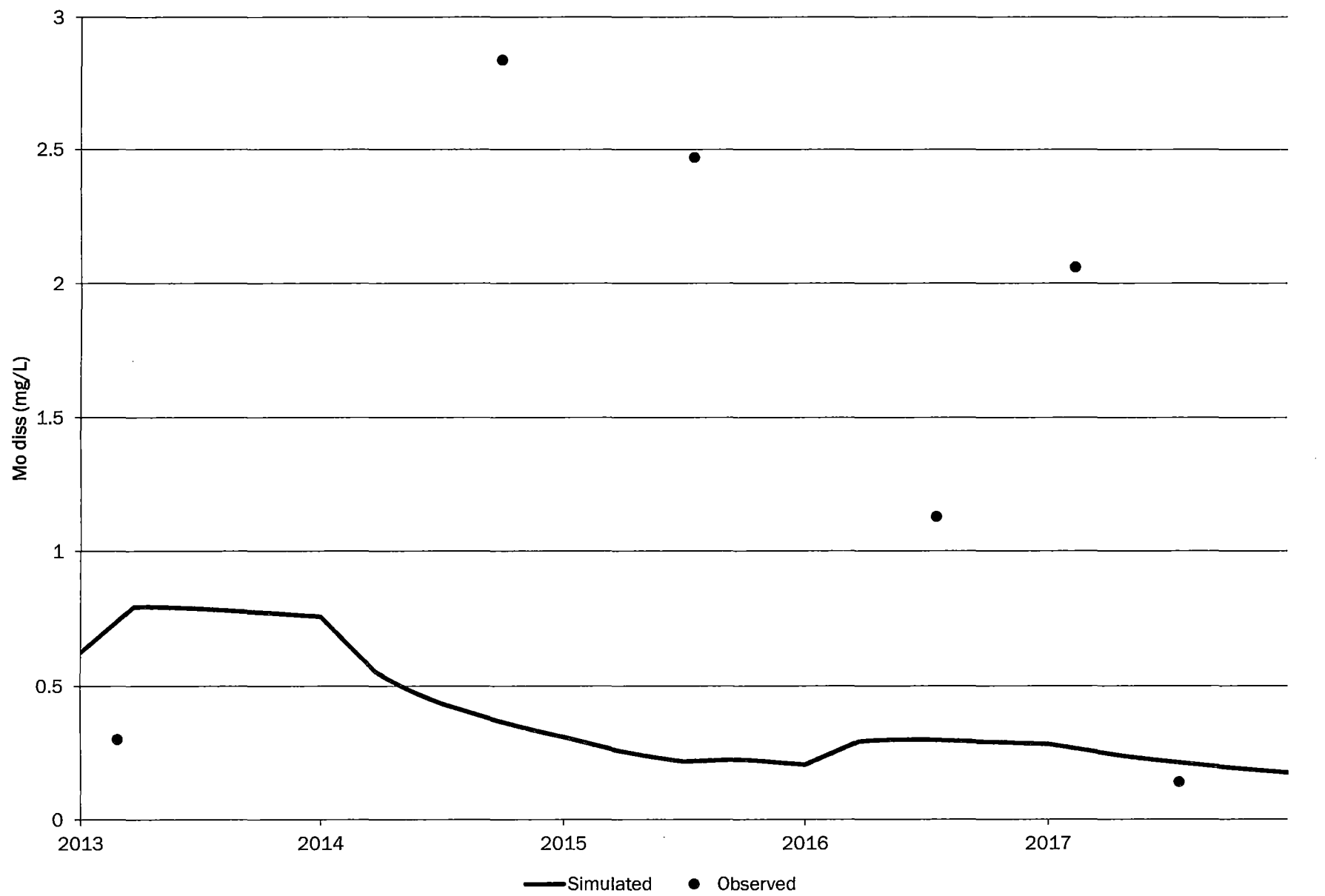
C12-AI



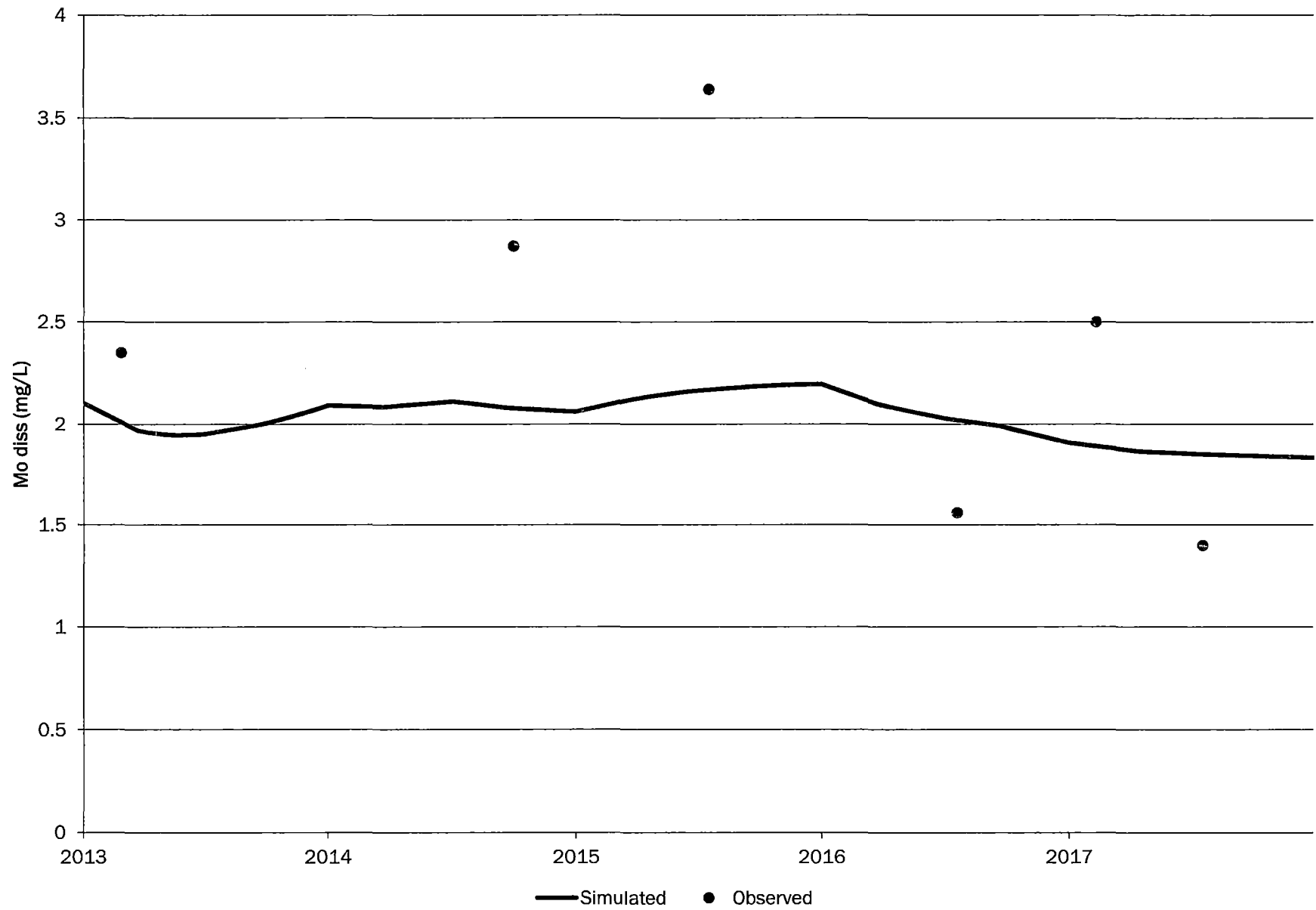
CE2-UC



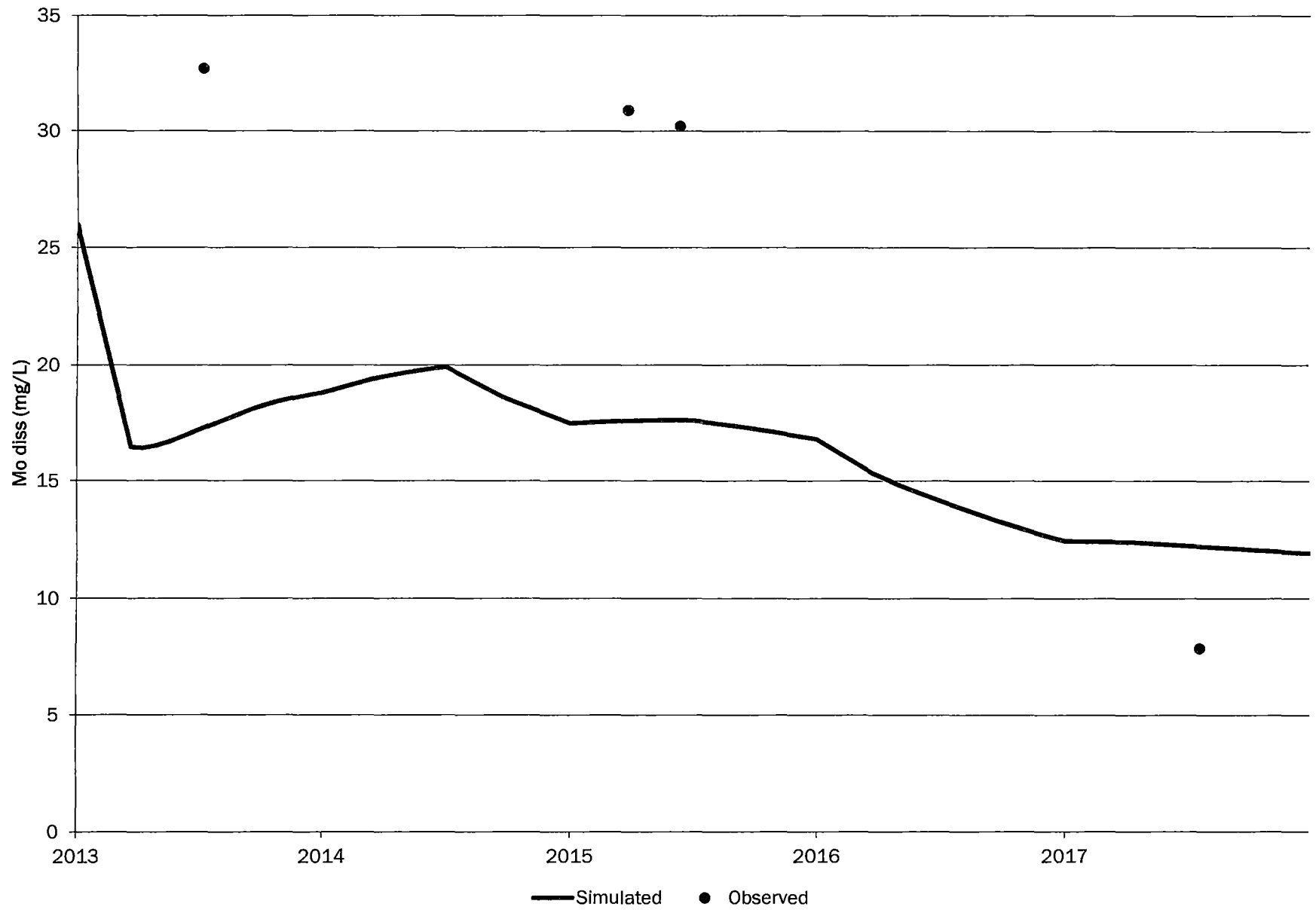
CE5-UC



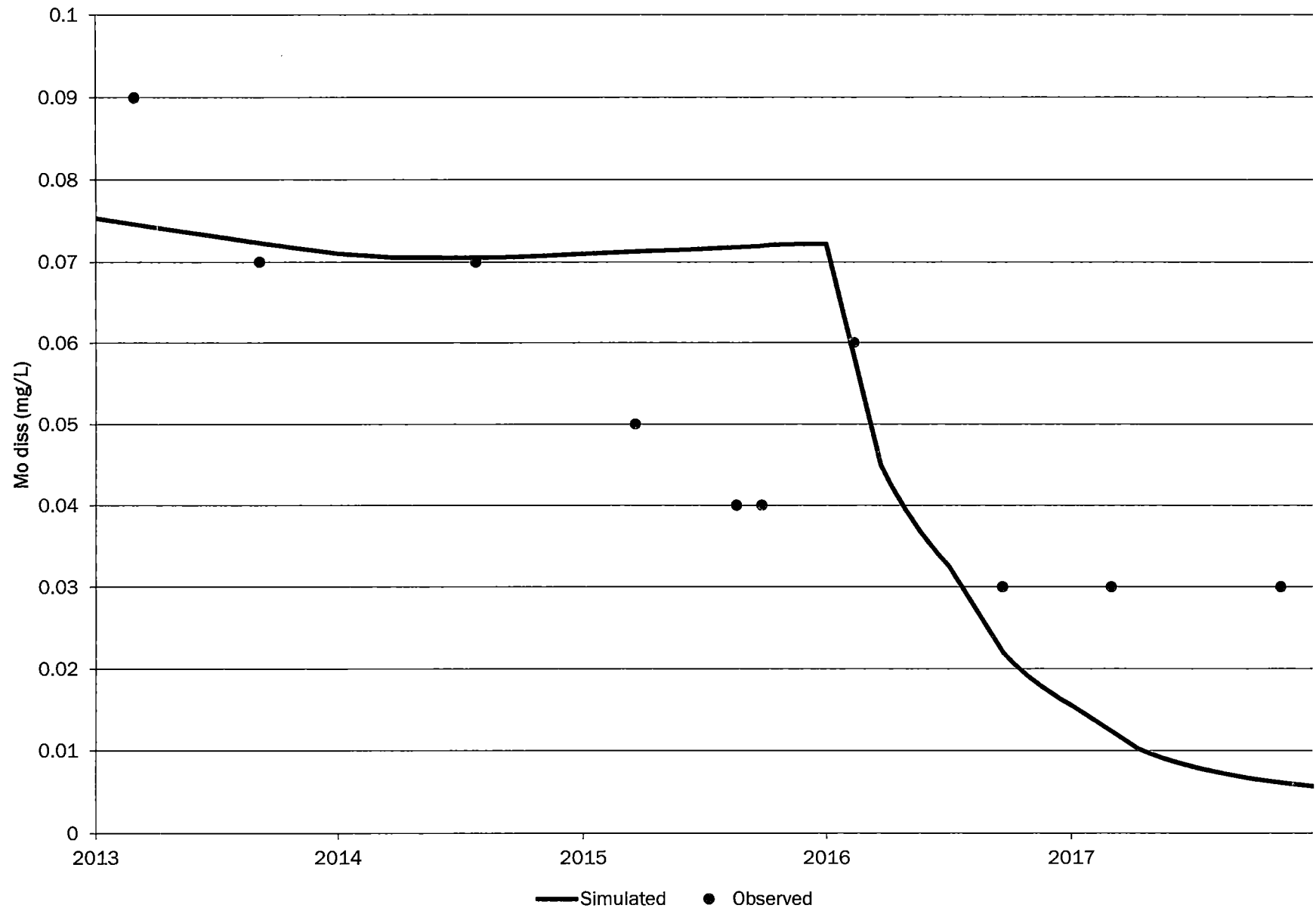
CE6-UC



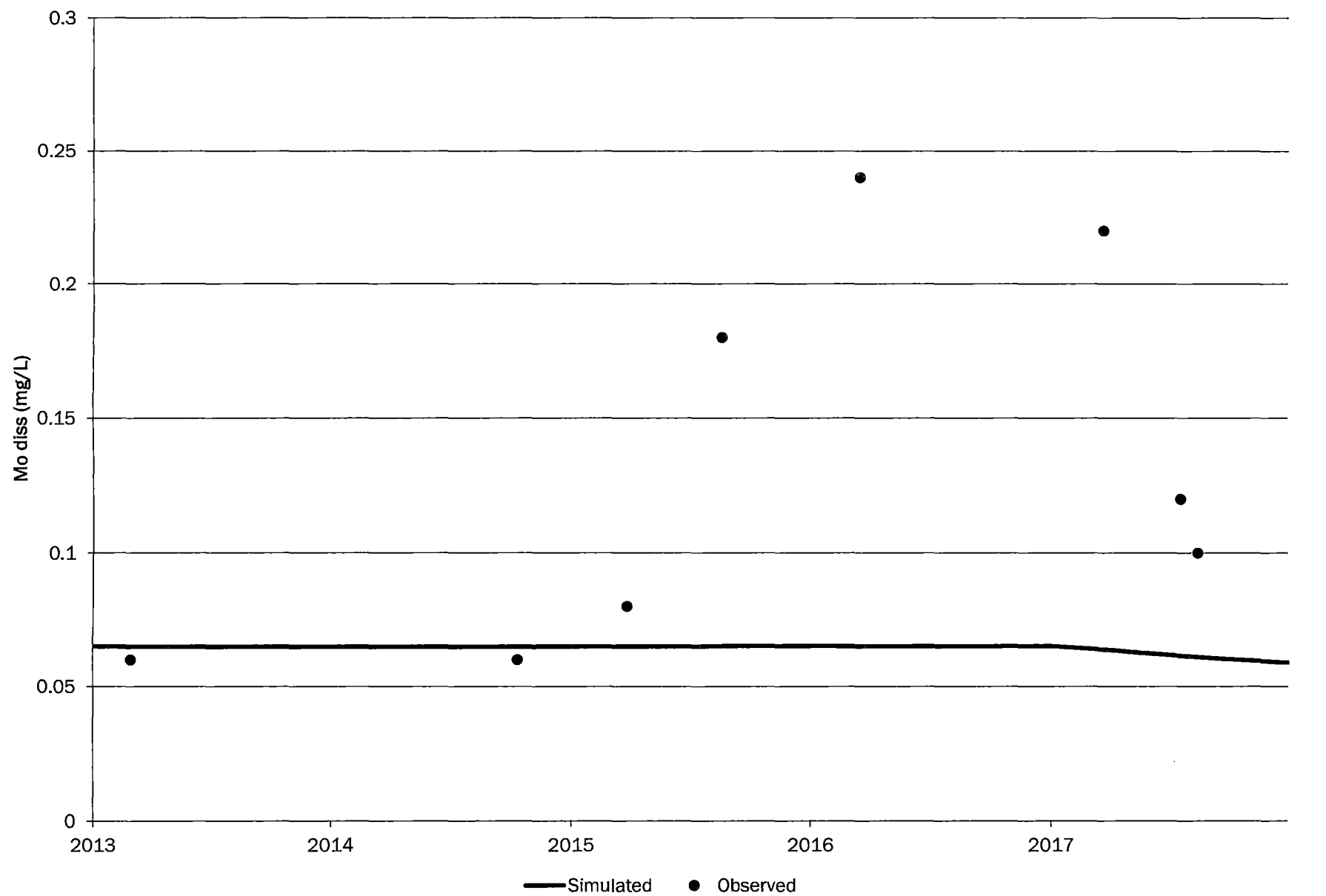
CE7-UC



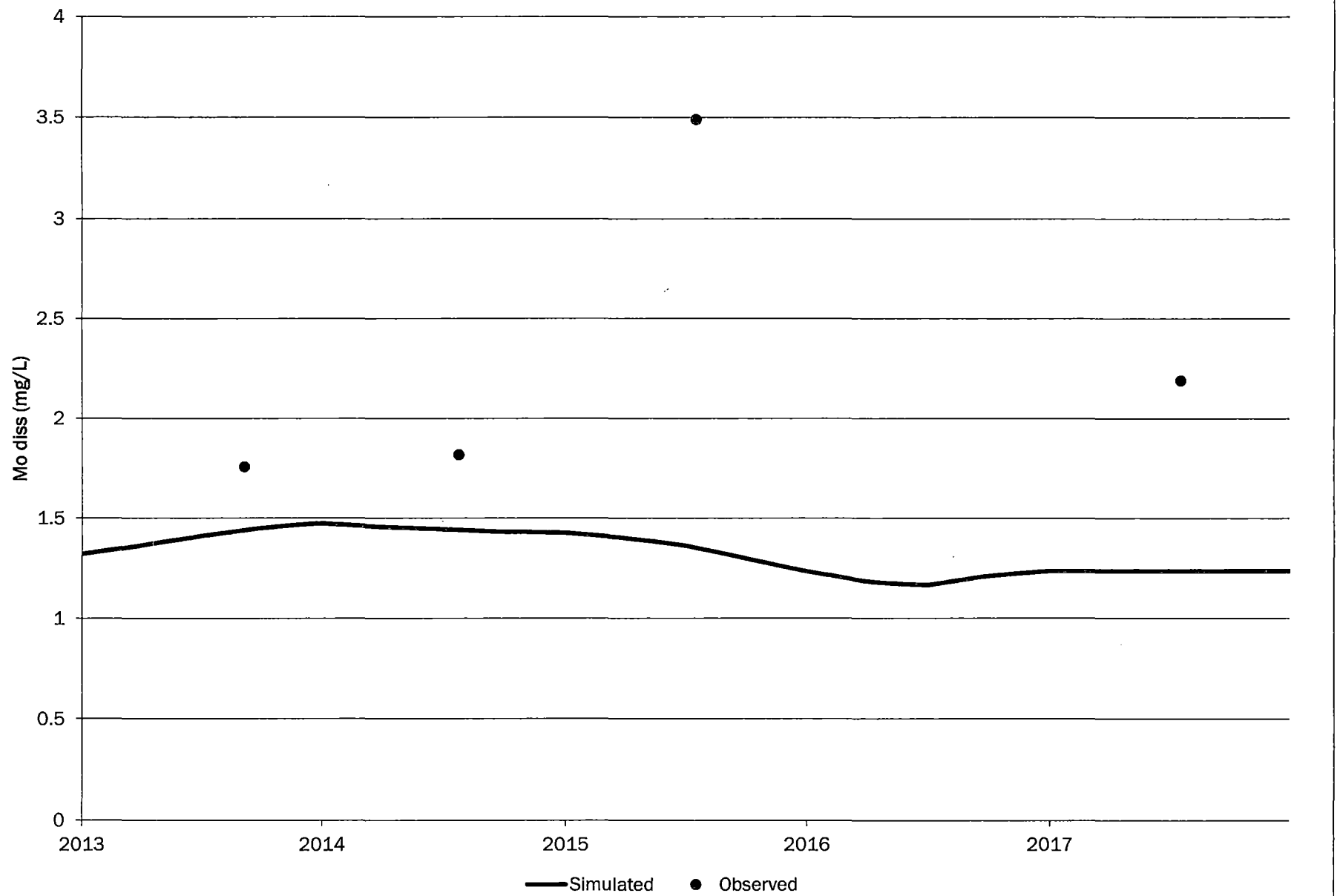
CE8-UC



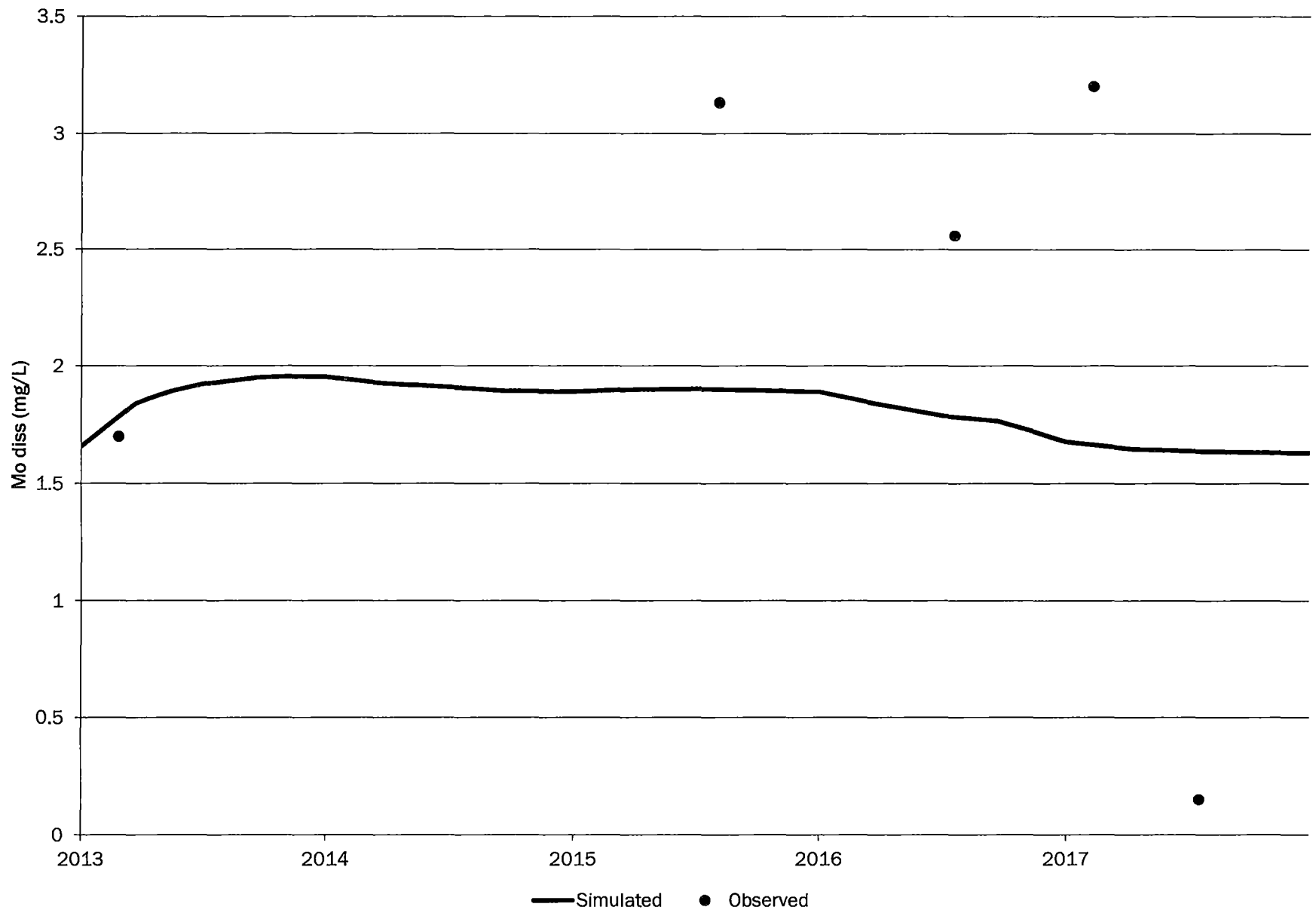
CE9-UC



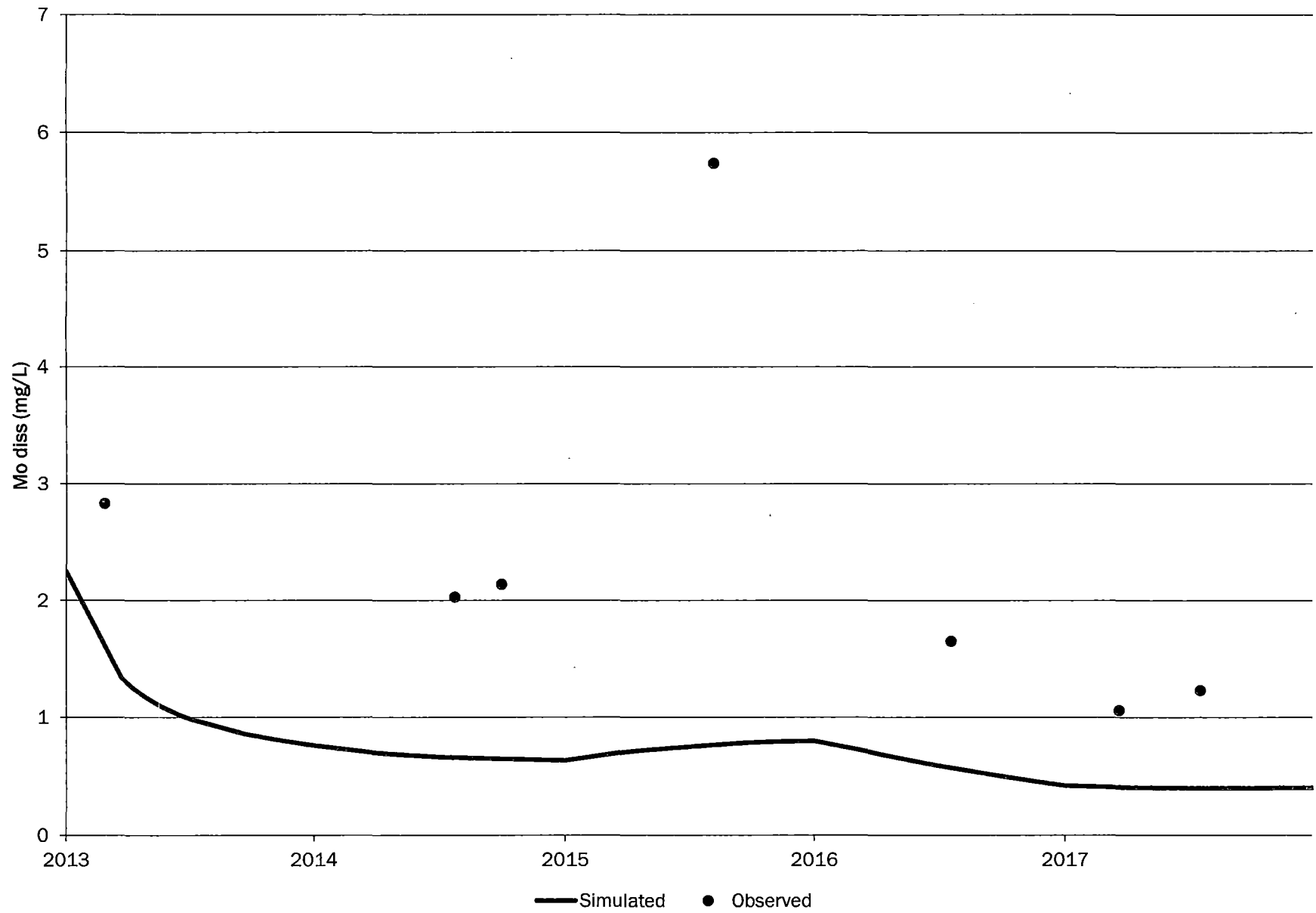
CE10-UC



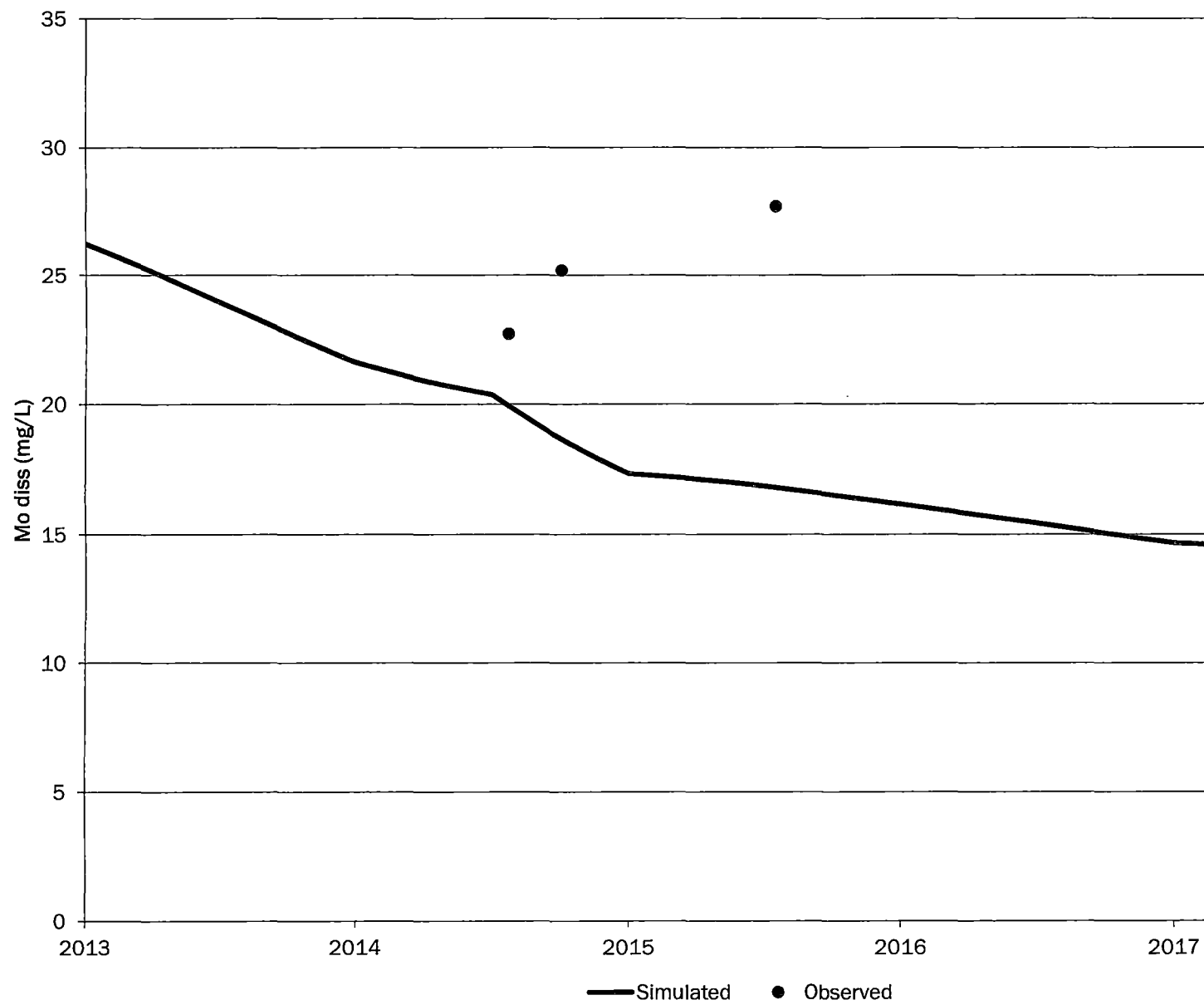
CE11-UC



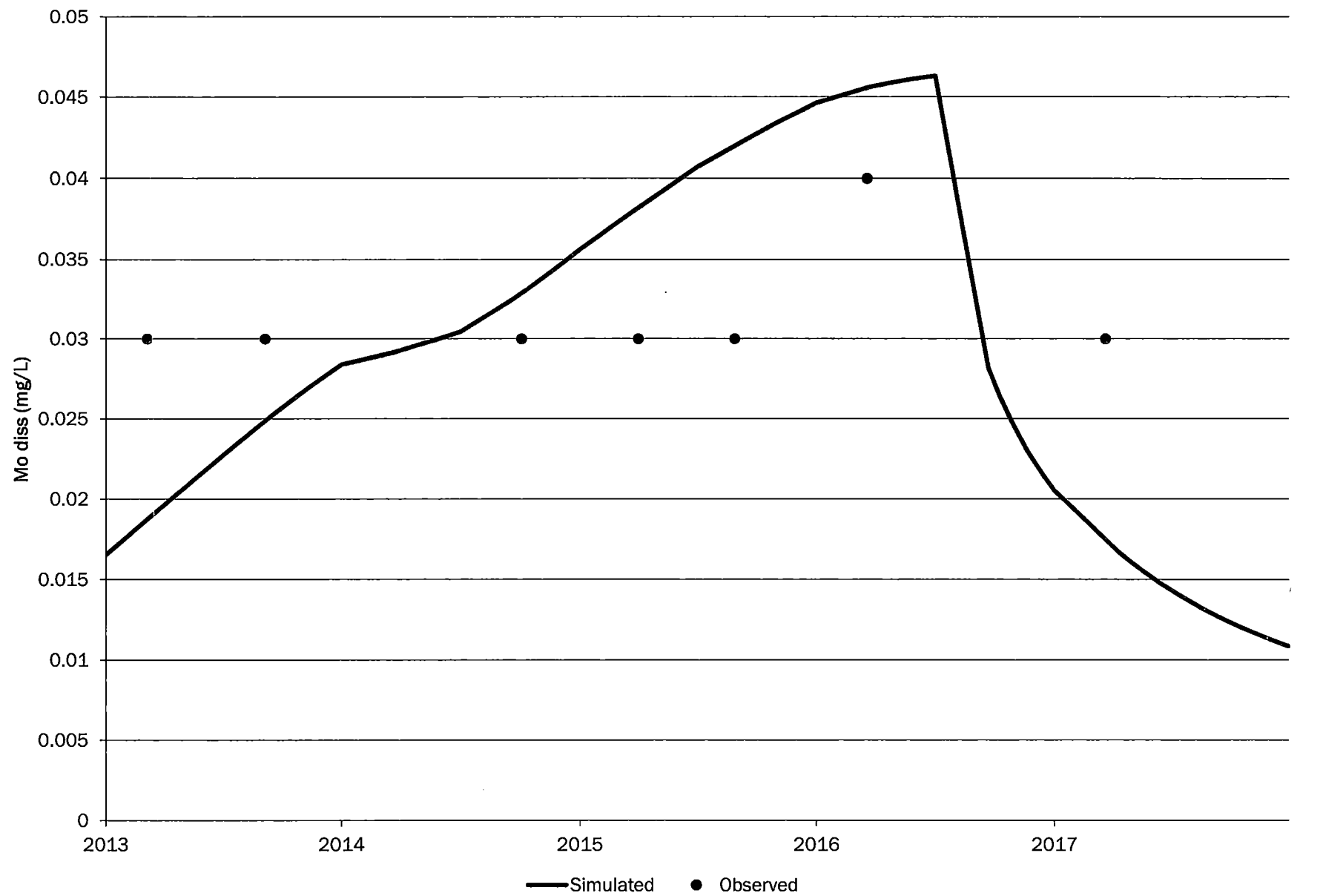
CE12-UC



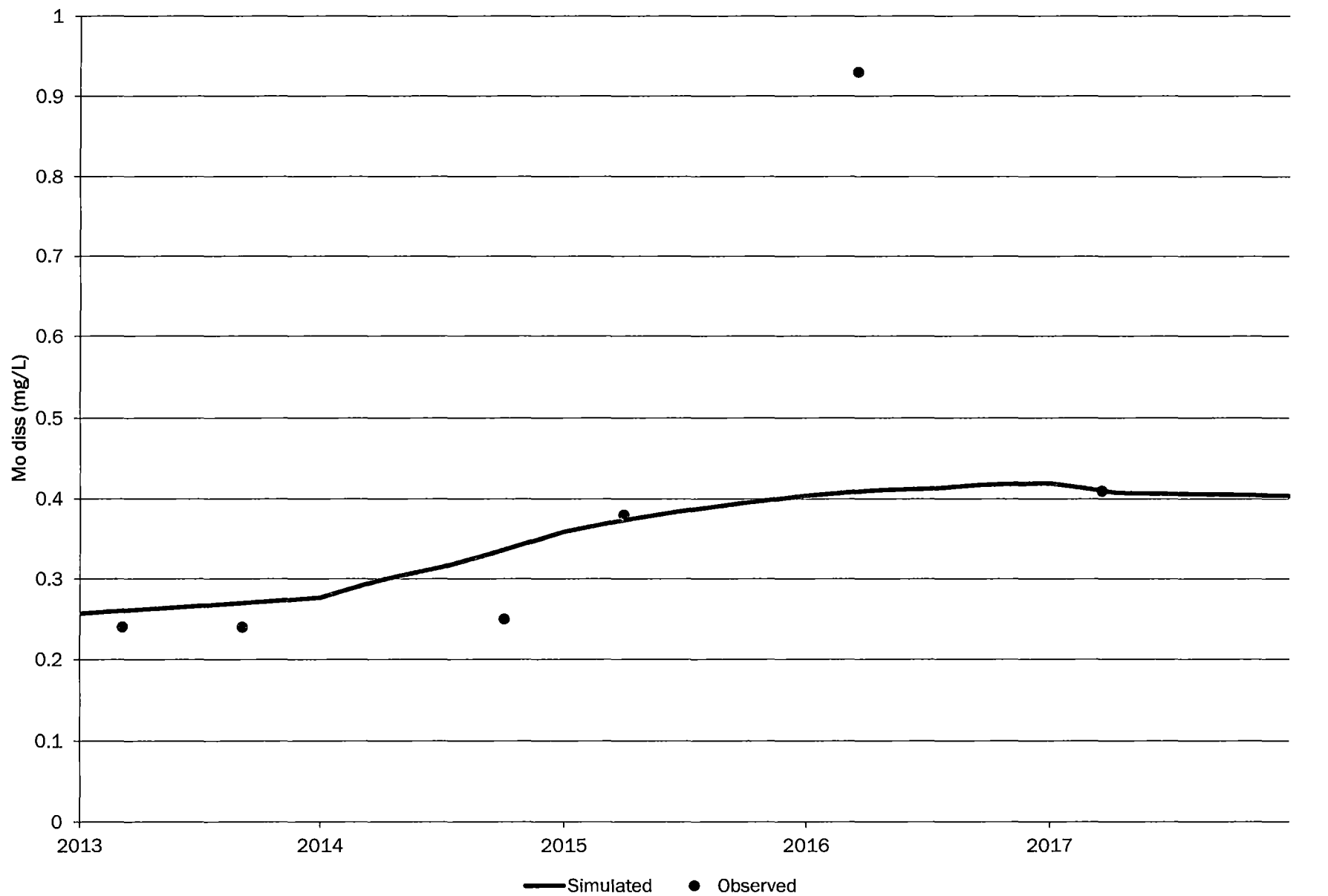
CE13-UC



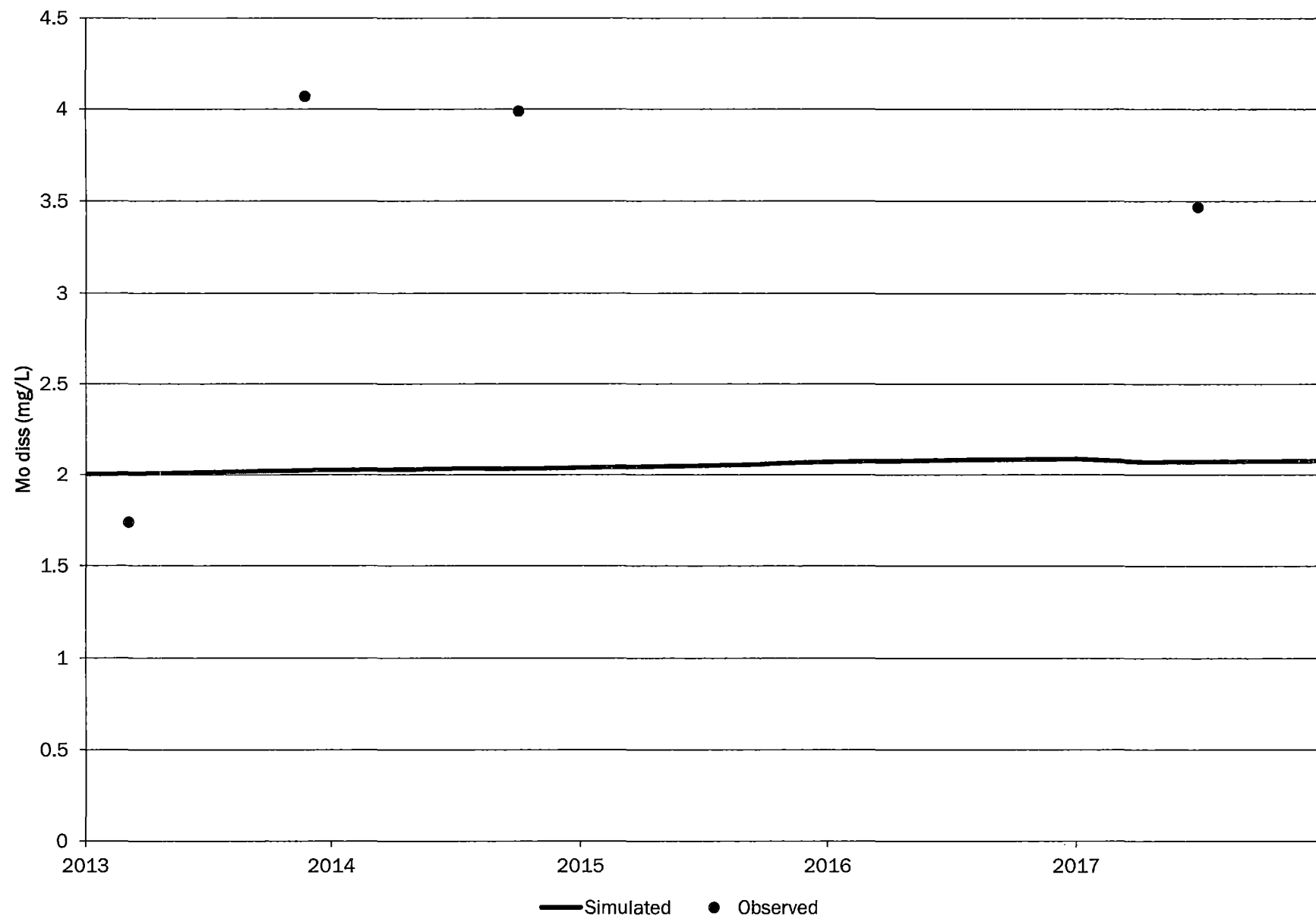
CE14-UC



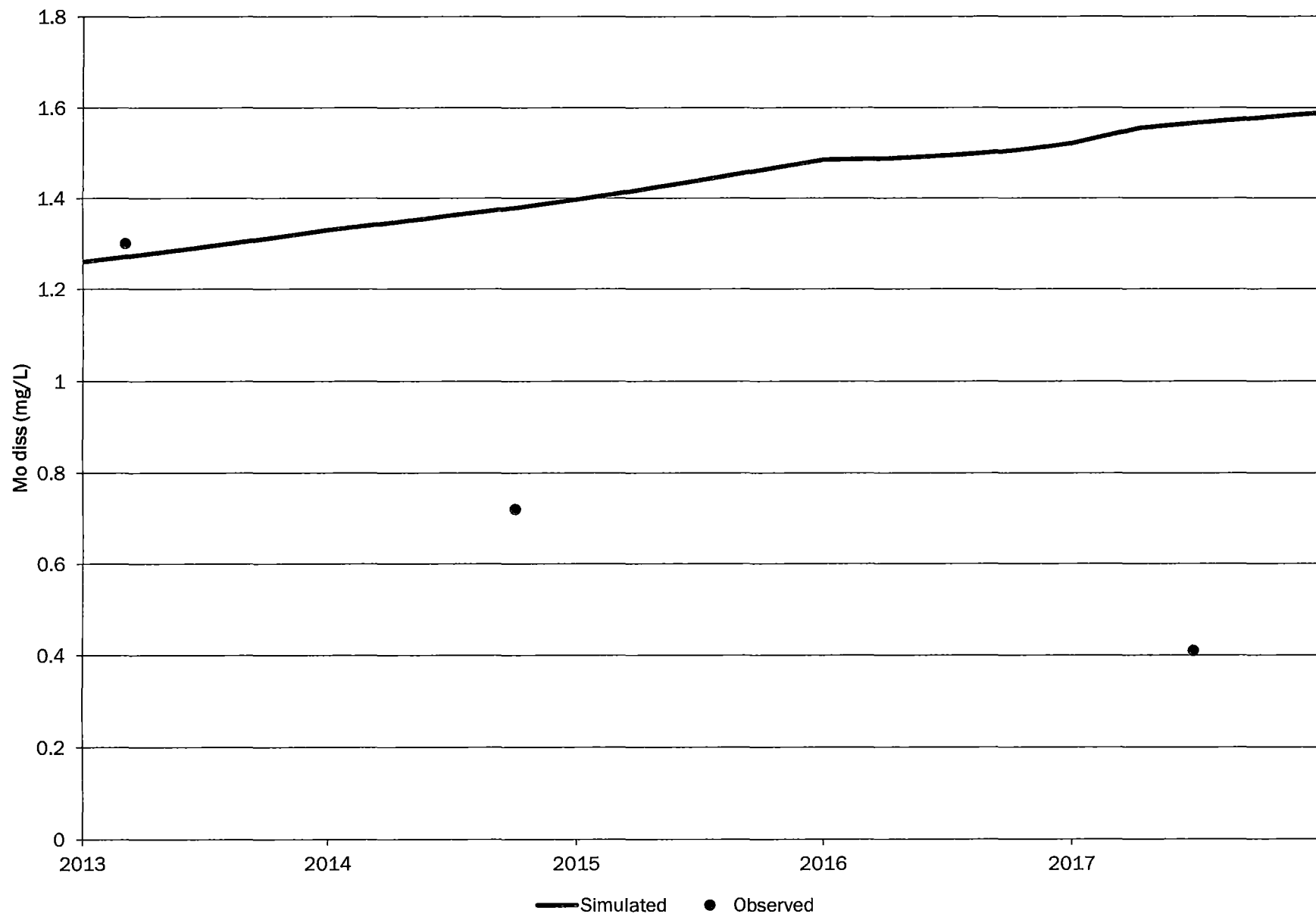
CE15-UC



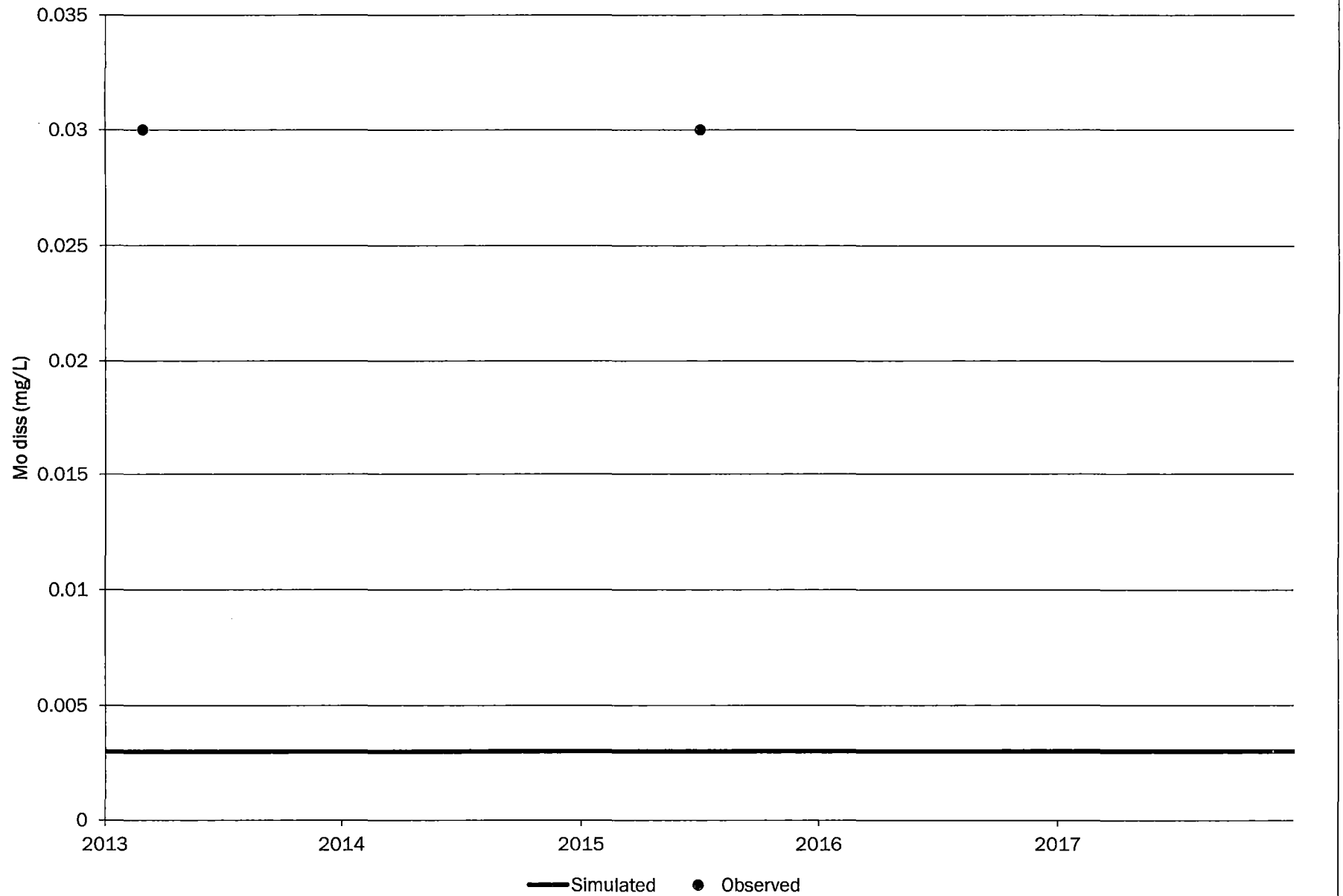
CF1-UC



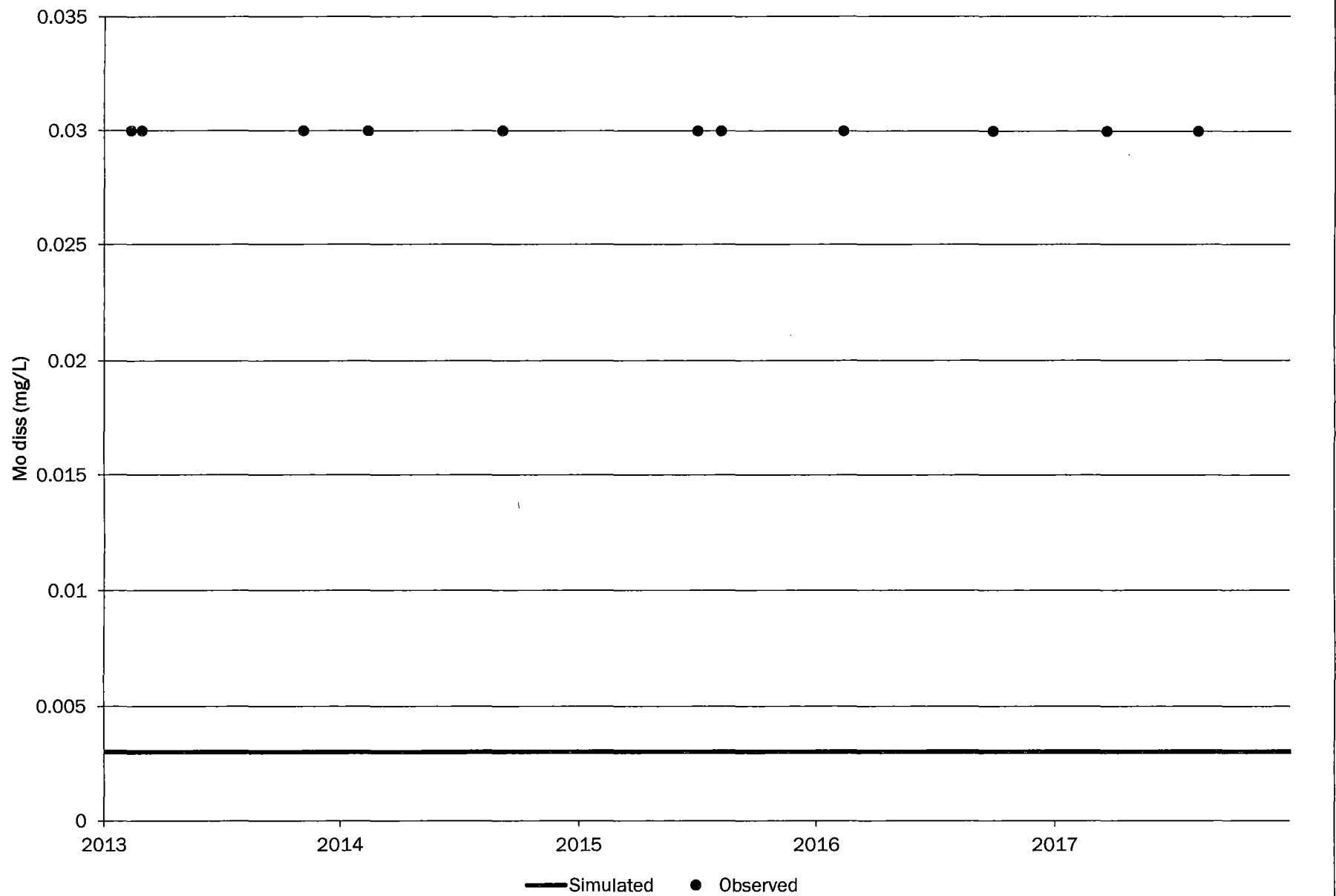
CF2-UC



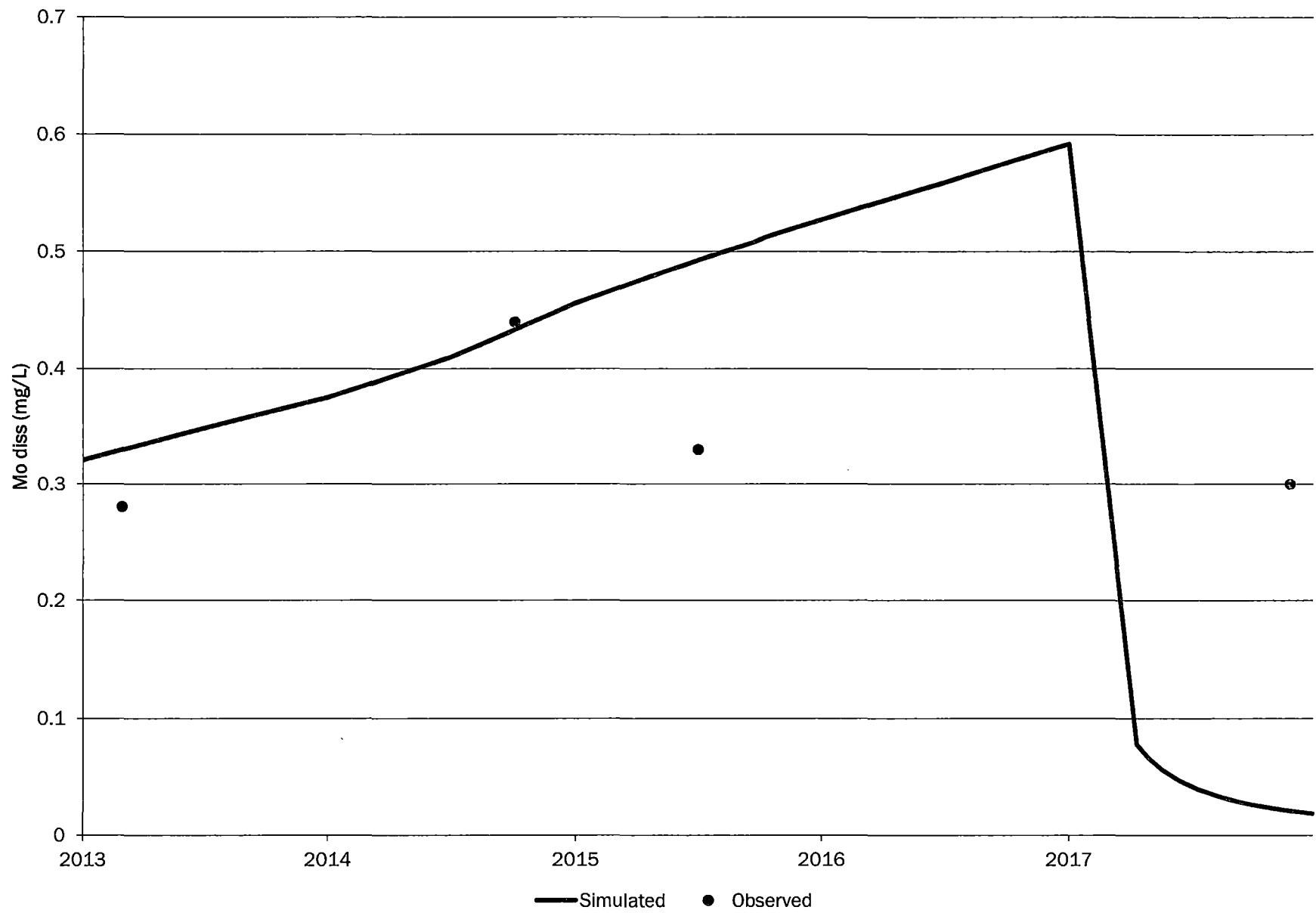
CW1-MC



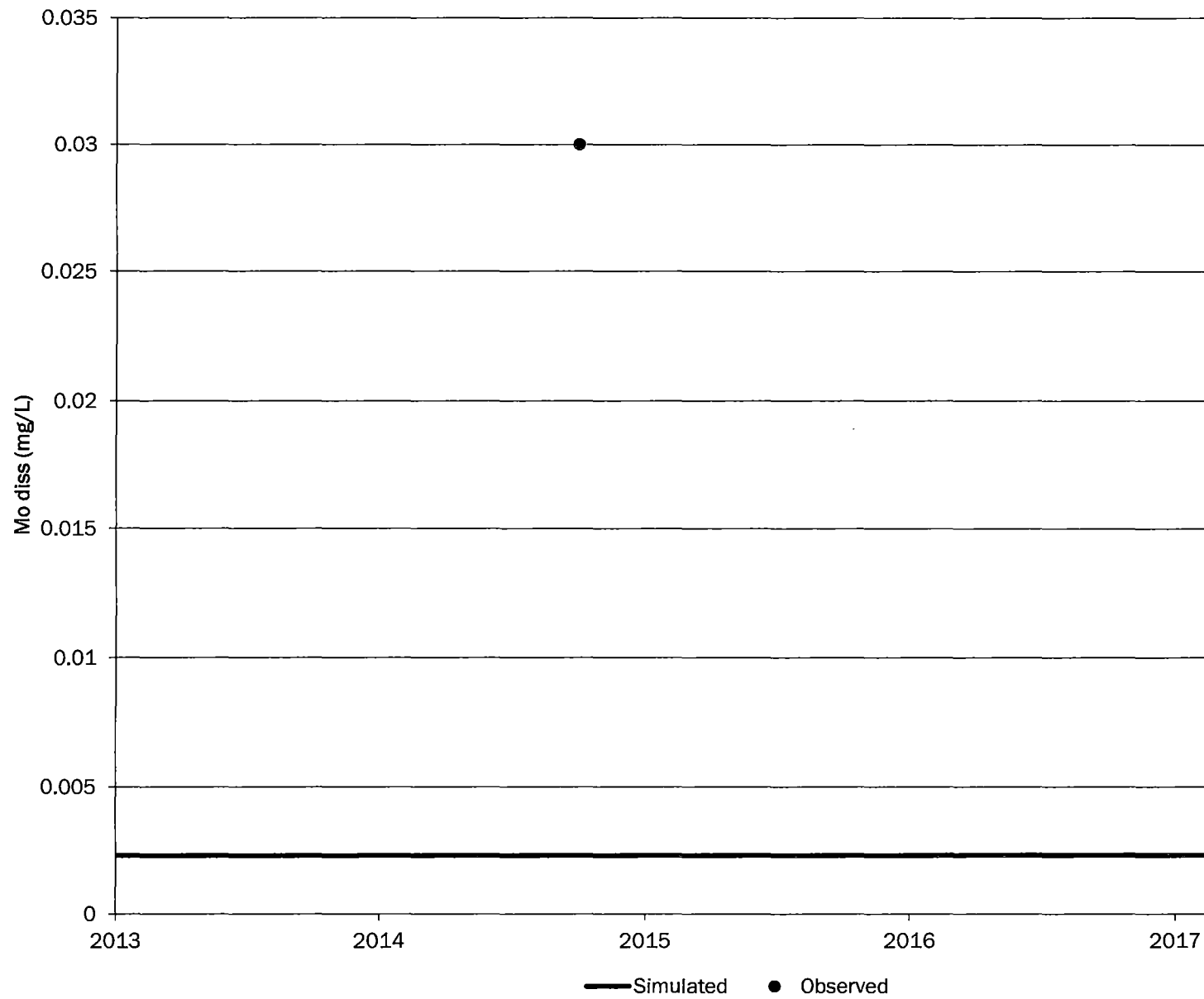
CW2-MC



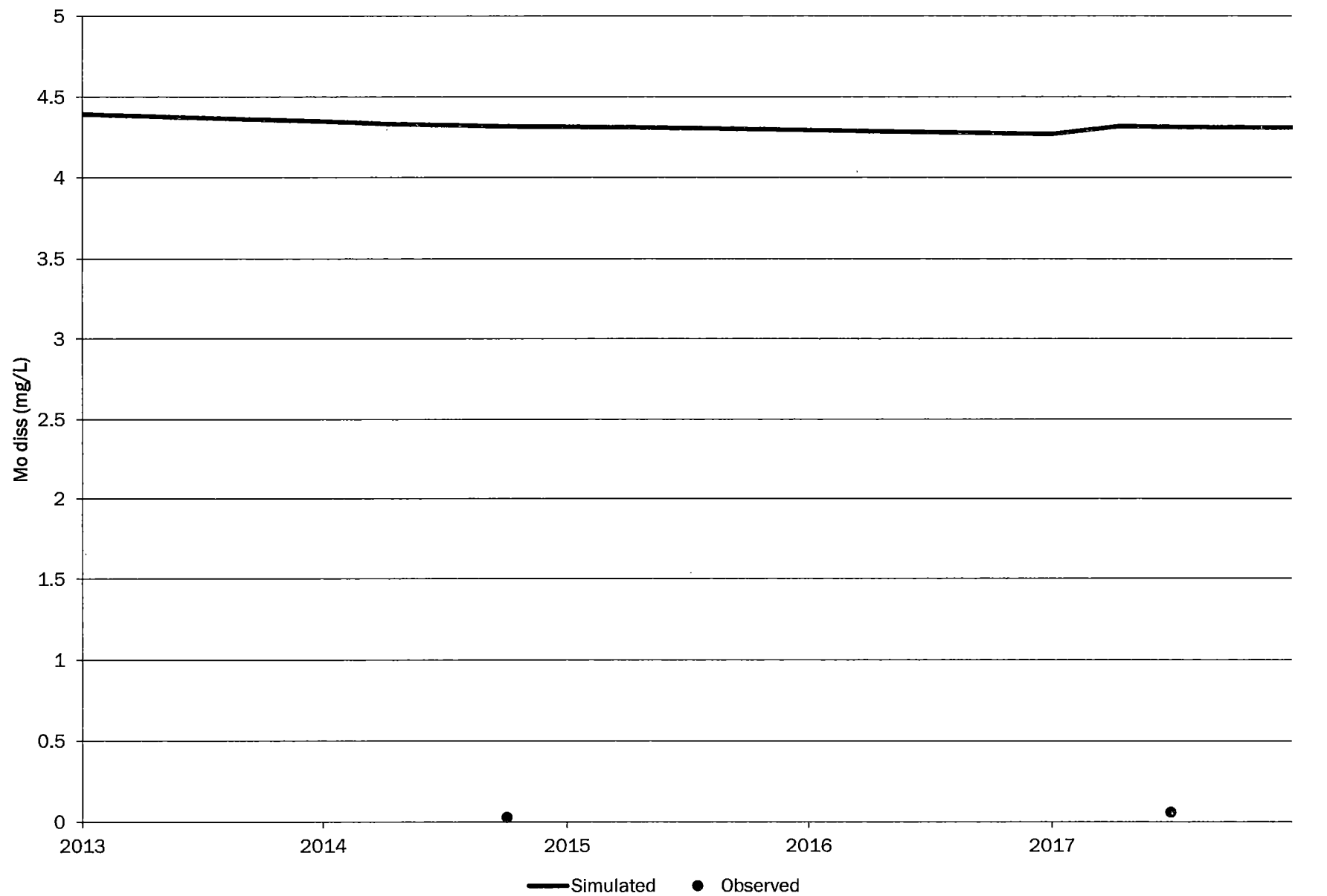
CW3-UC



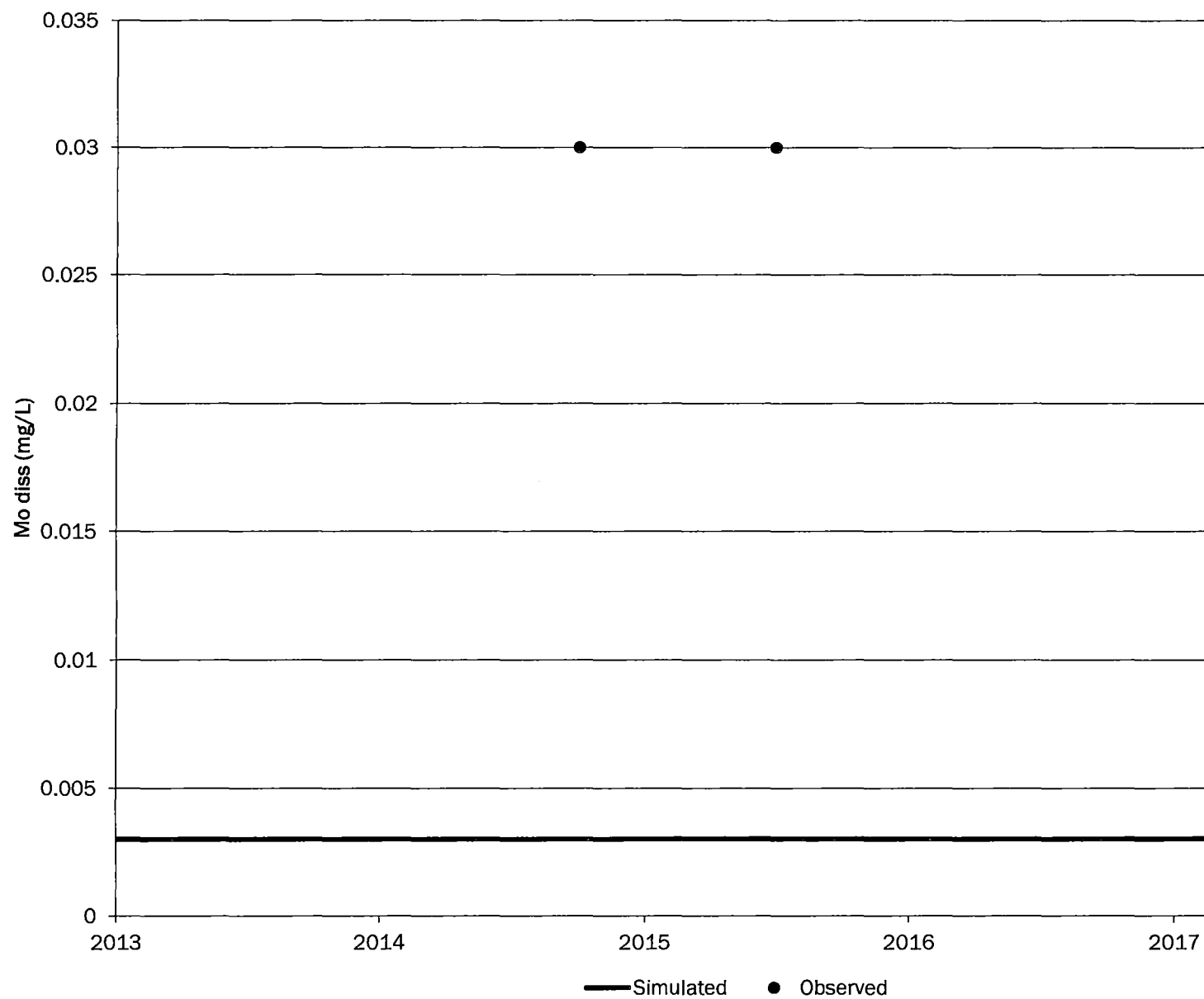
CW6-MC



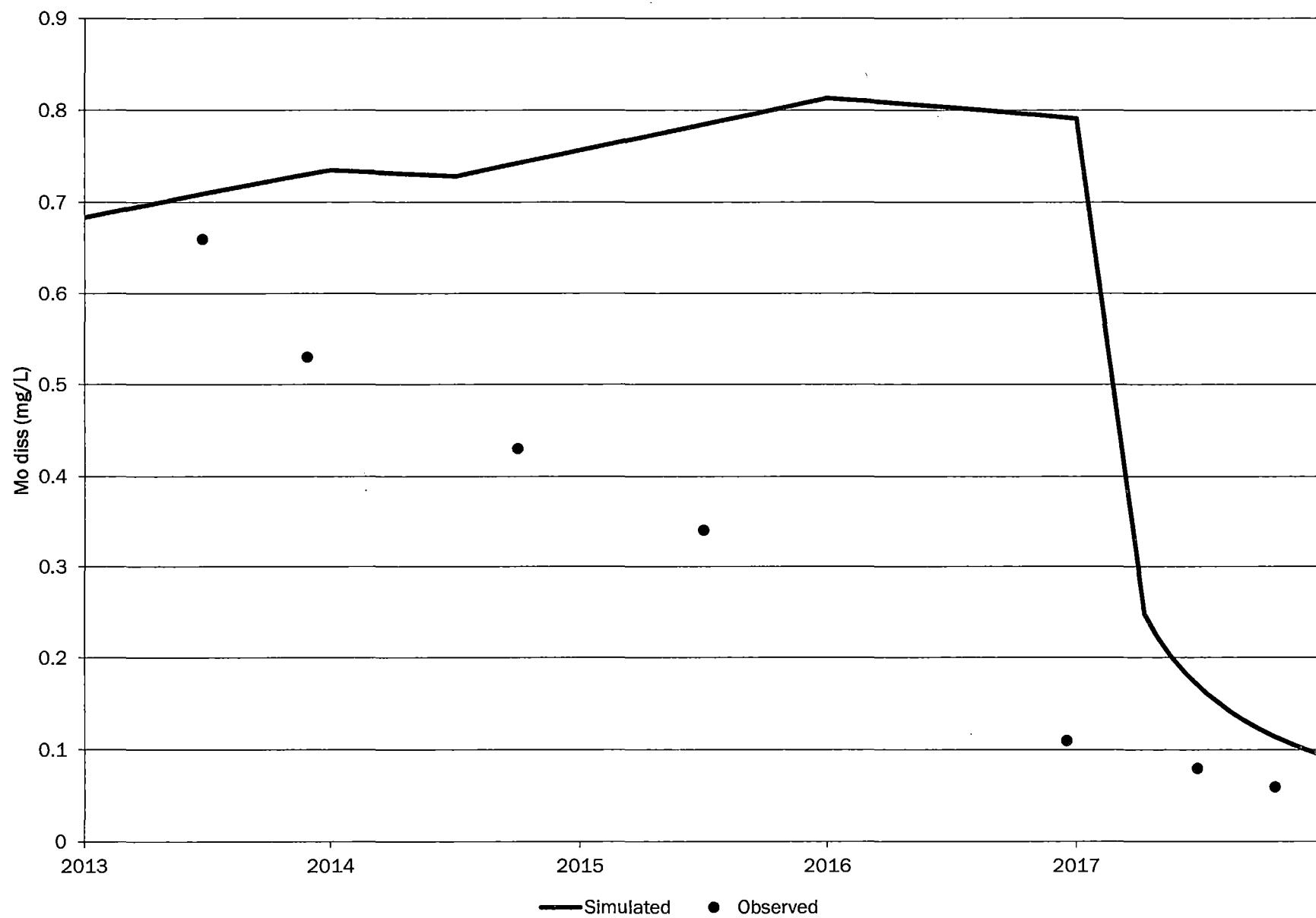
CW9-UC



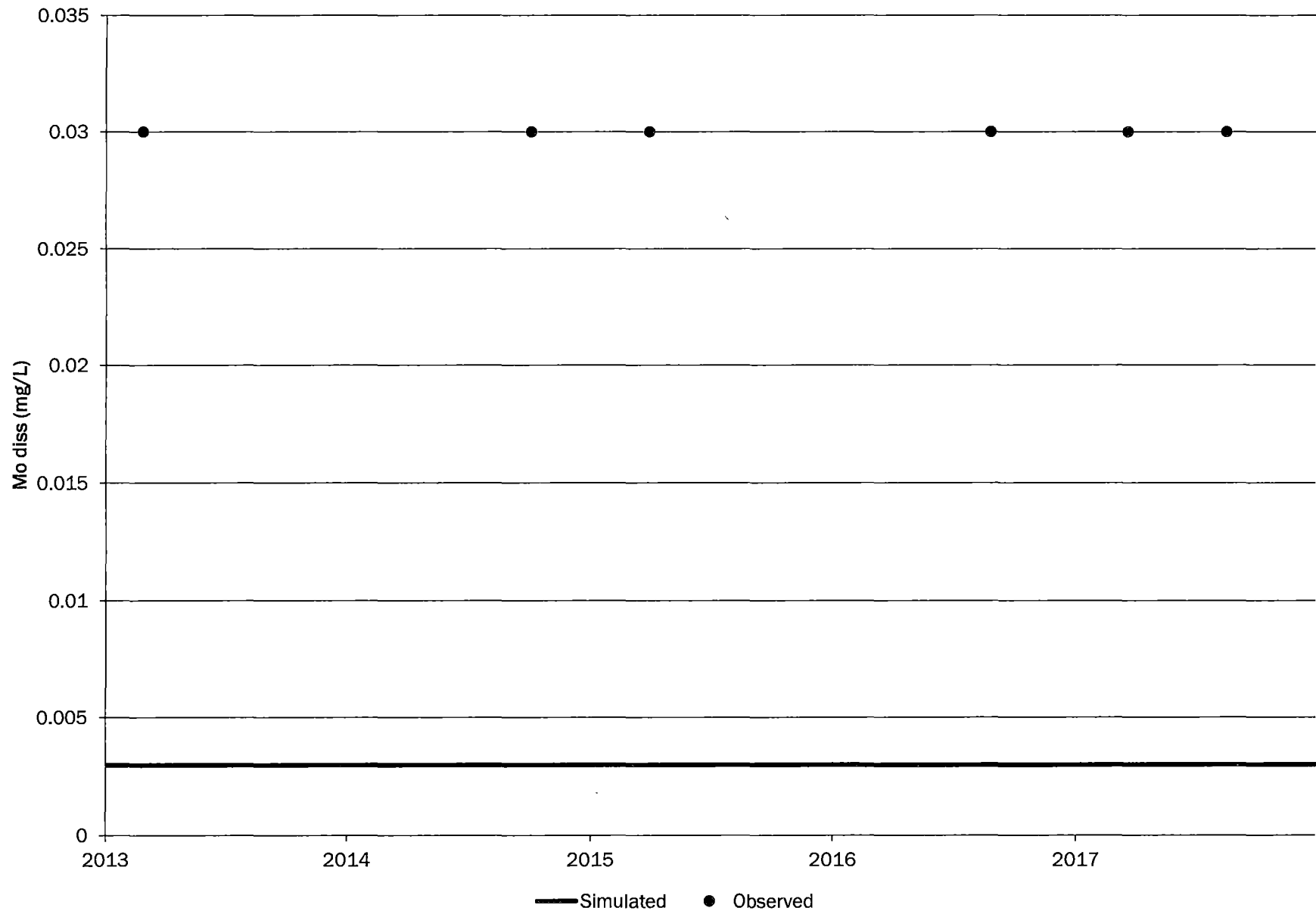
CW15-MC



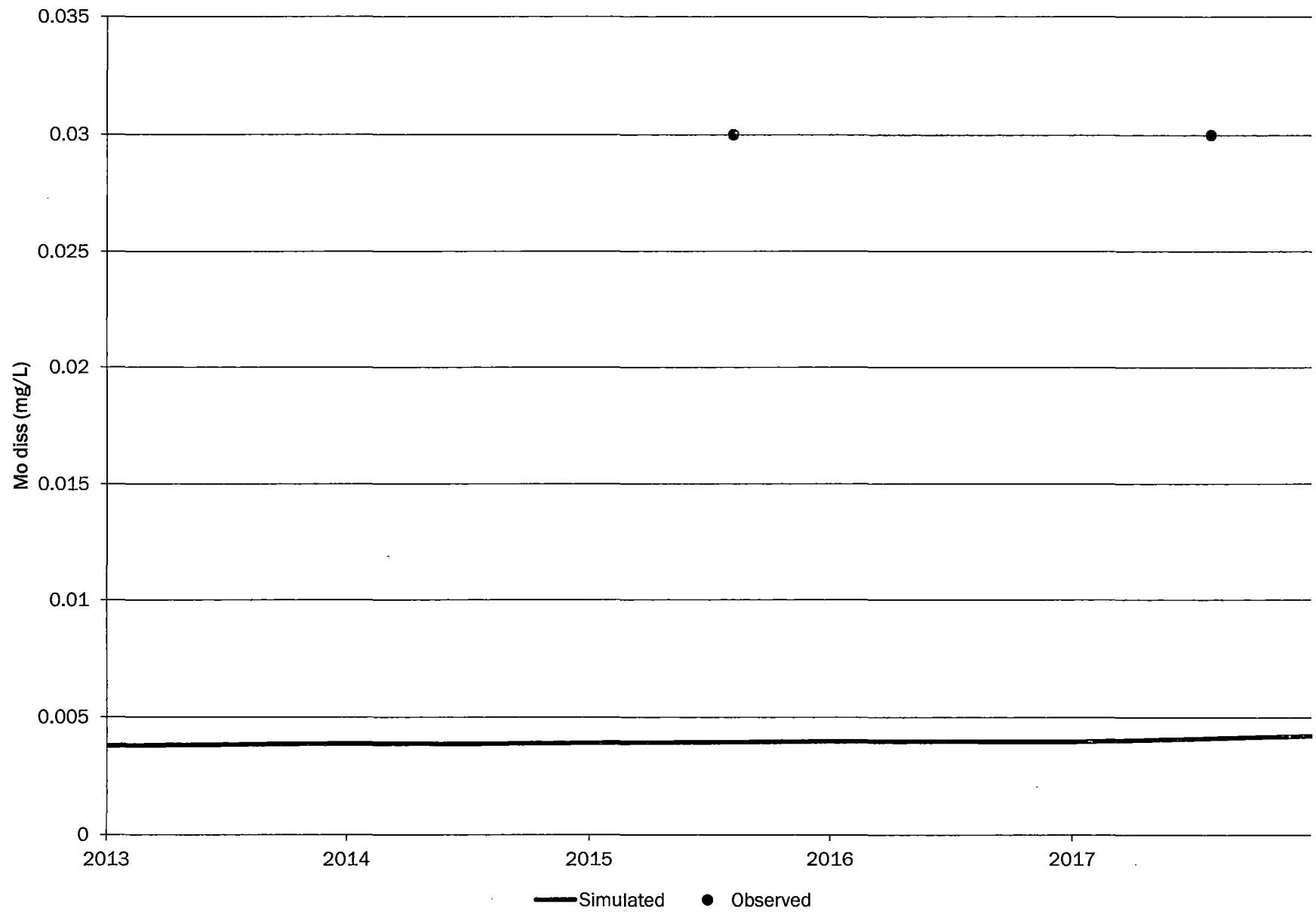
CW17-MC



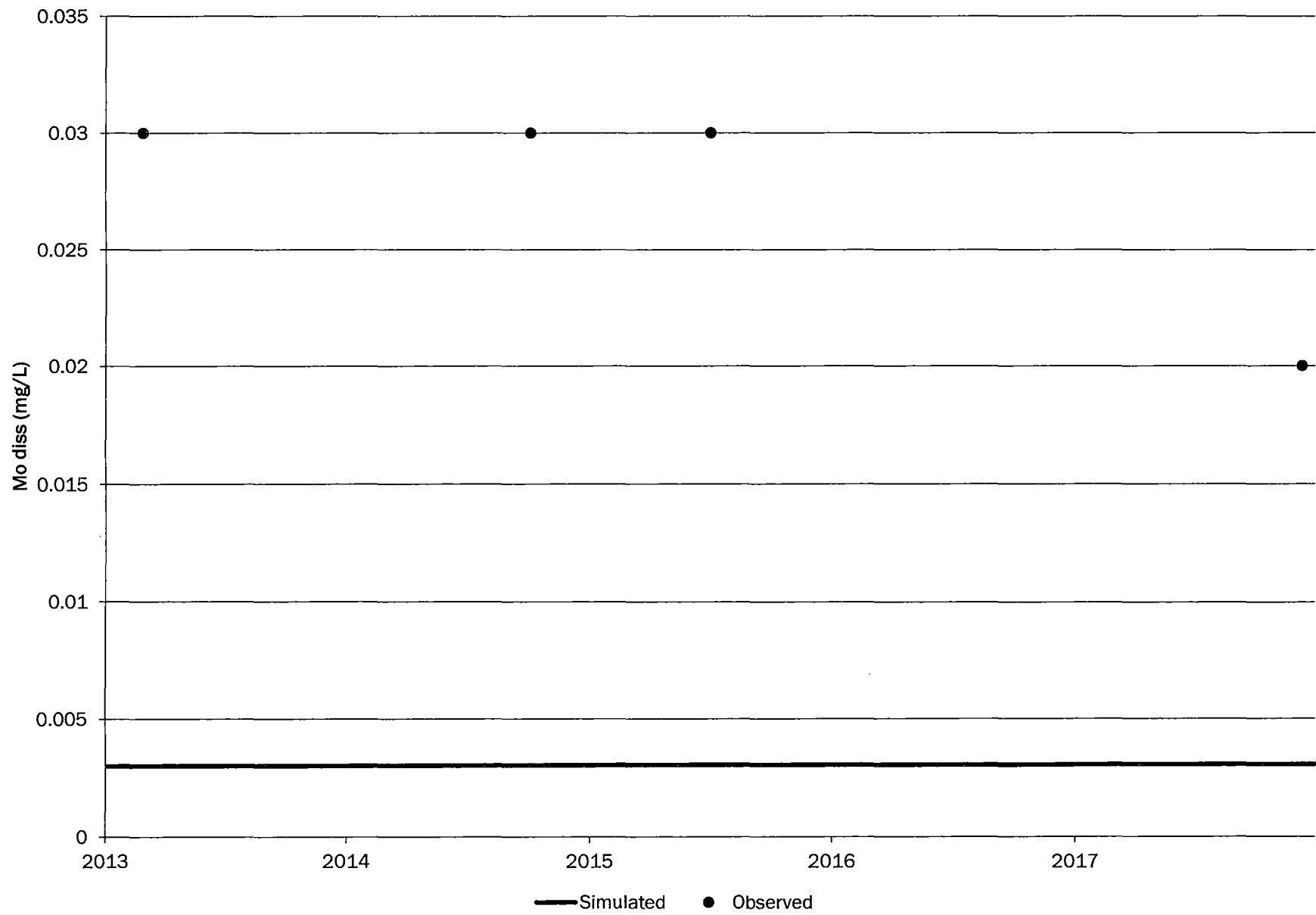
CW18-UC



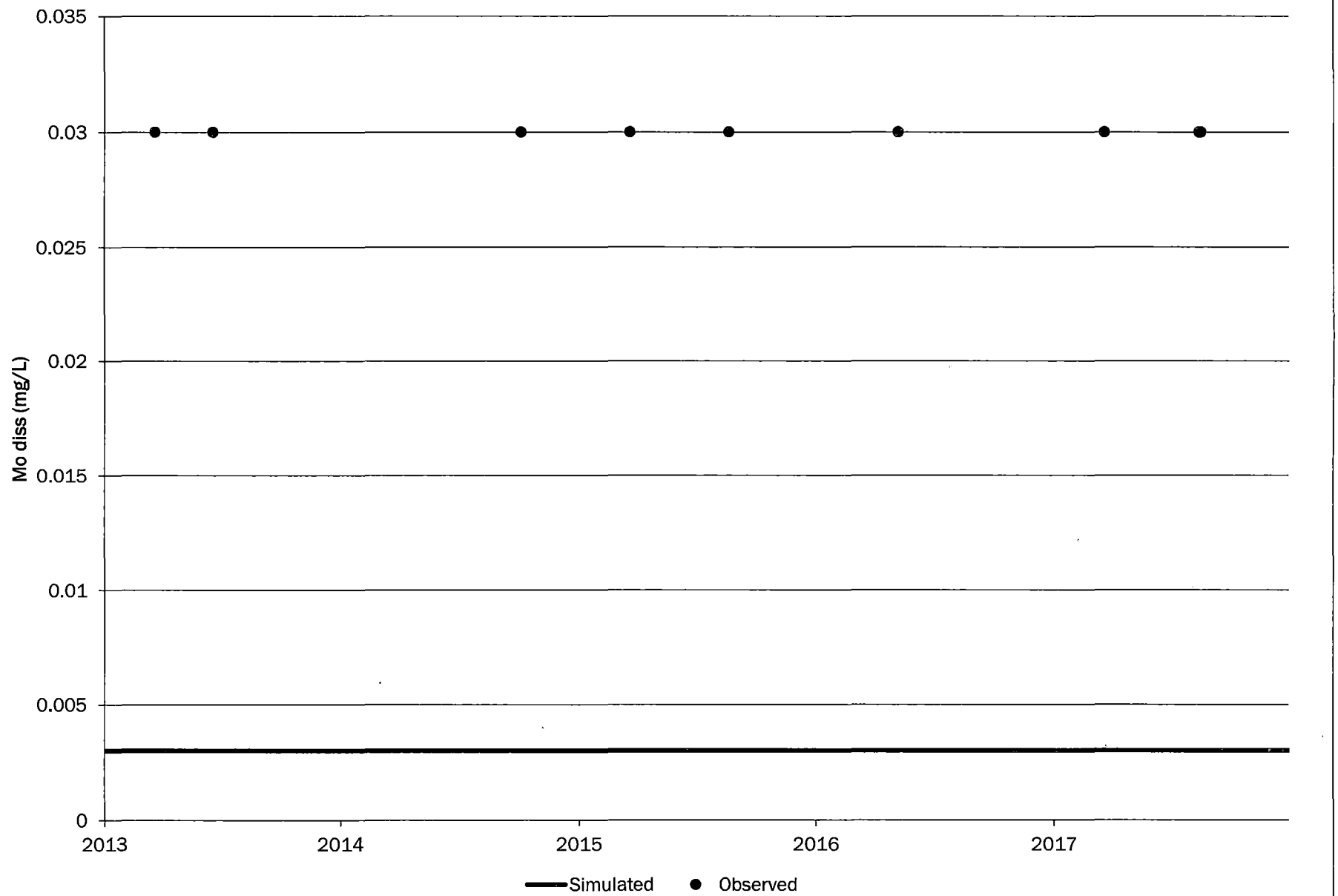
CW24-MC



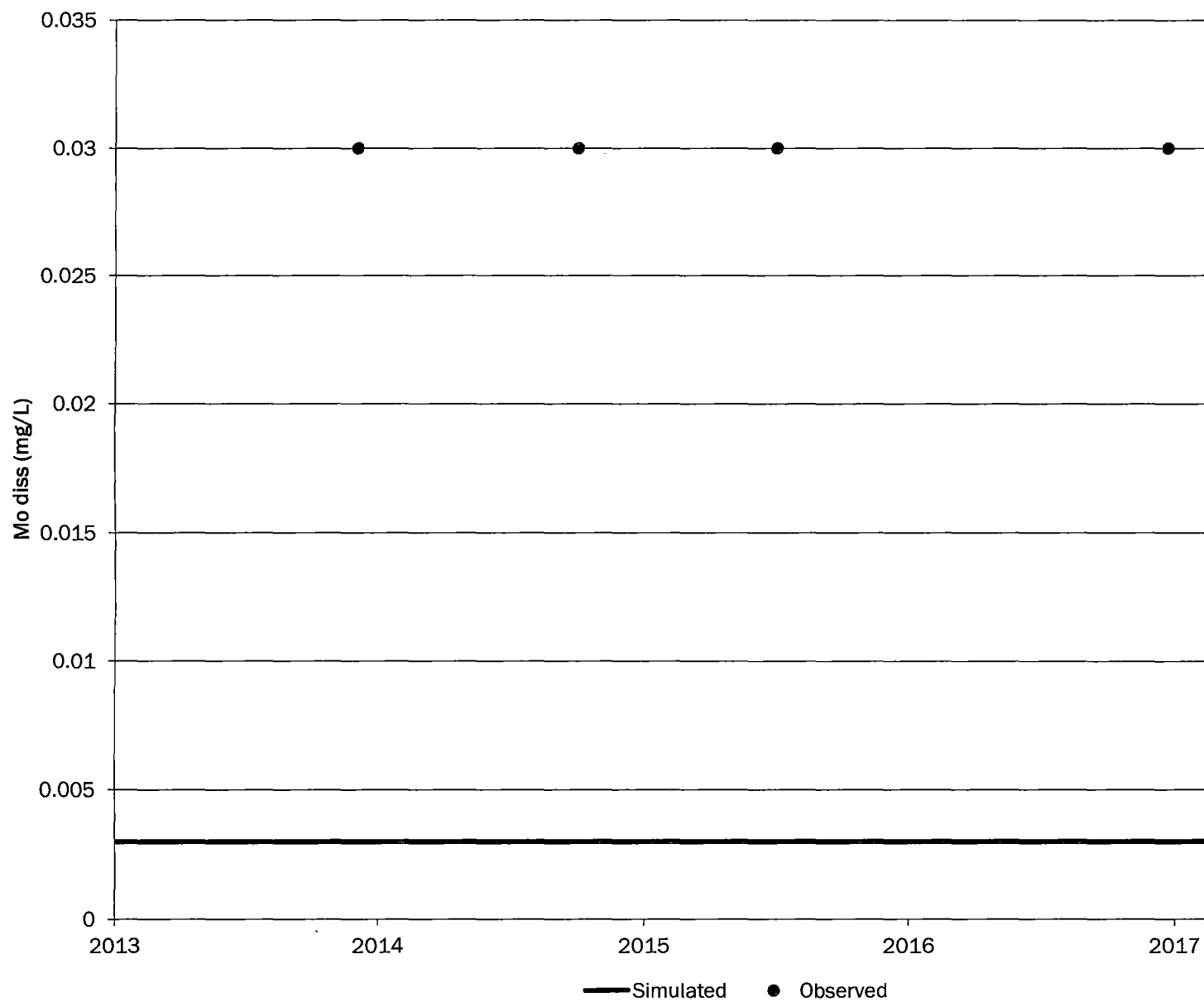
CW28-MC



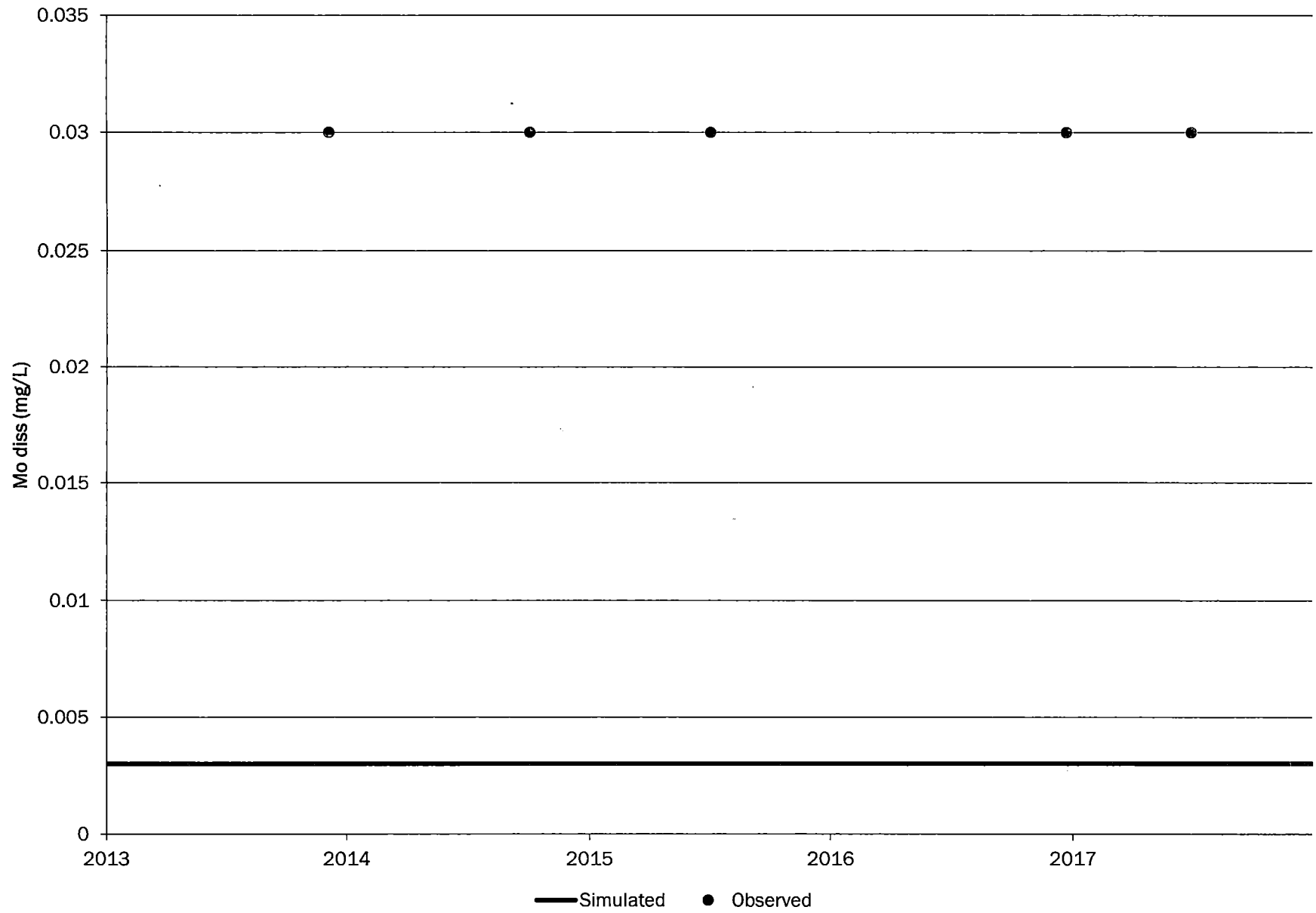
CW29-LC



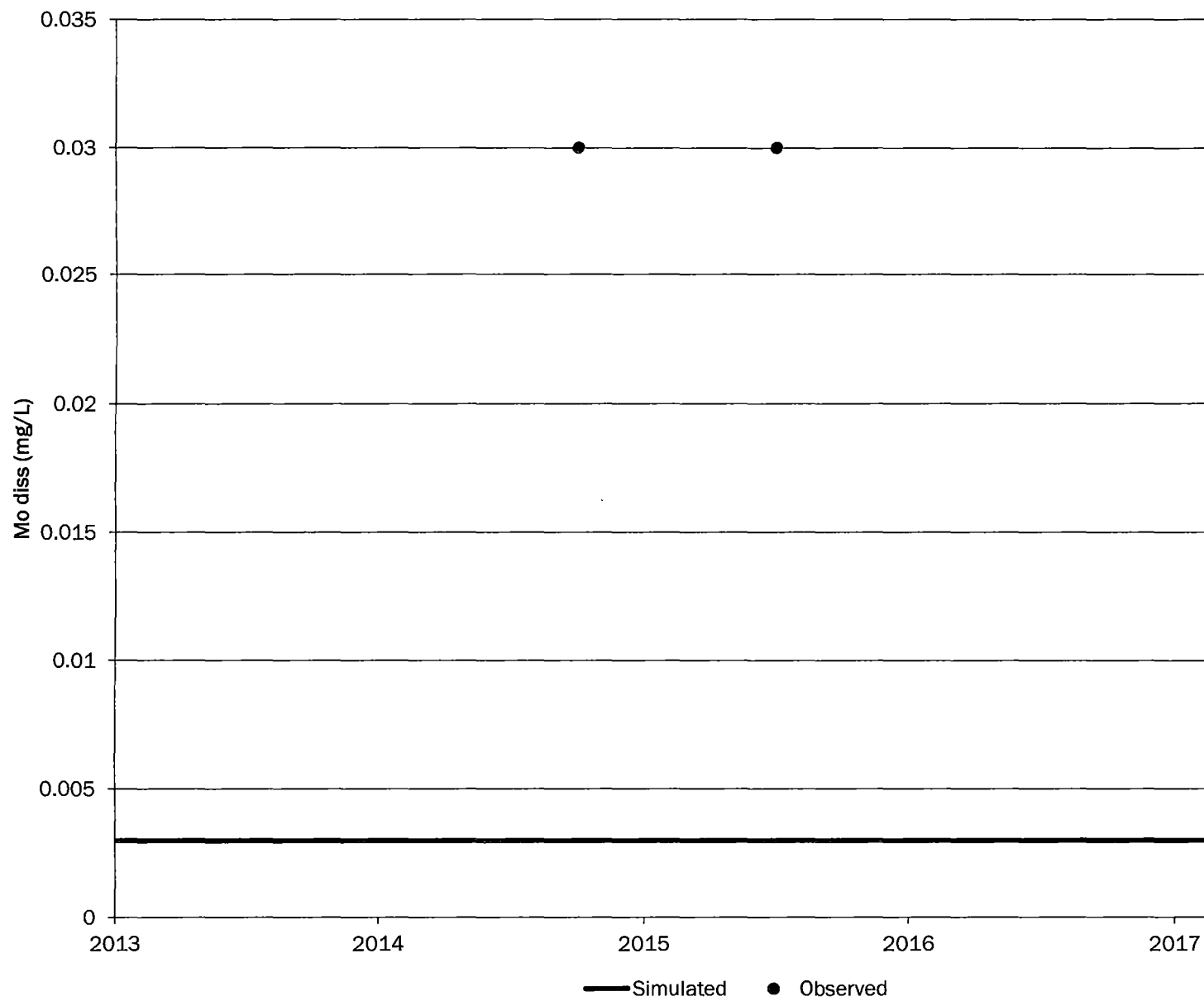
CW31-LC



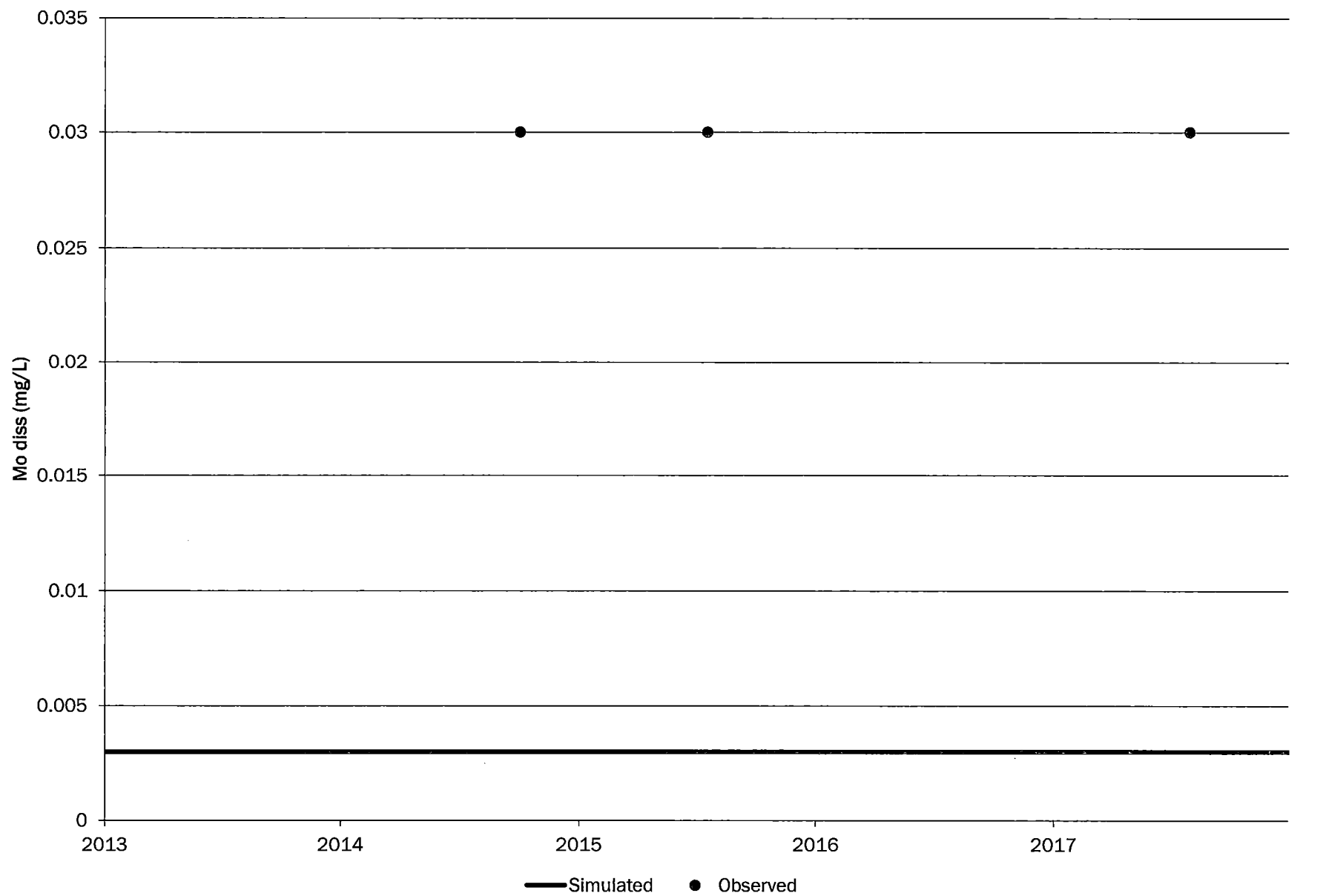
CW32-LC



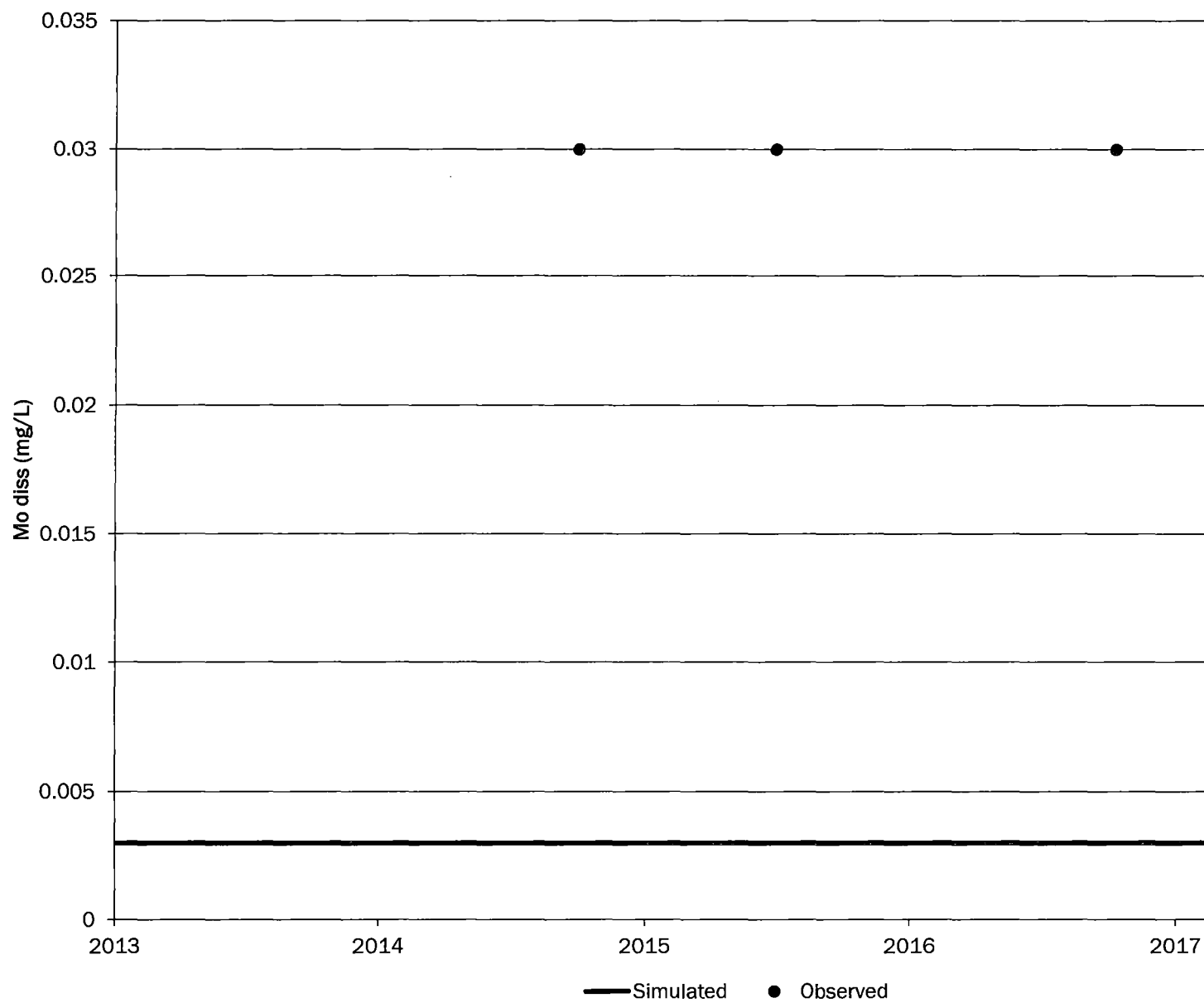
CW33-LC



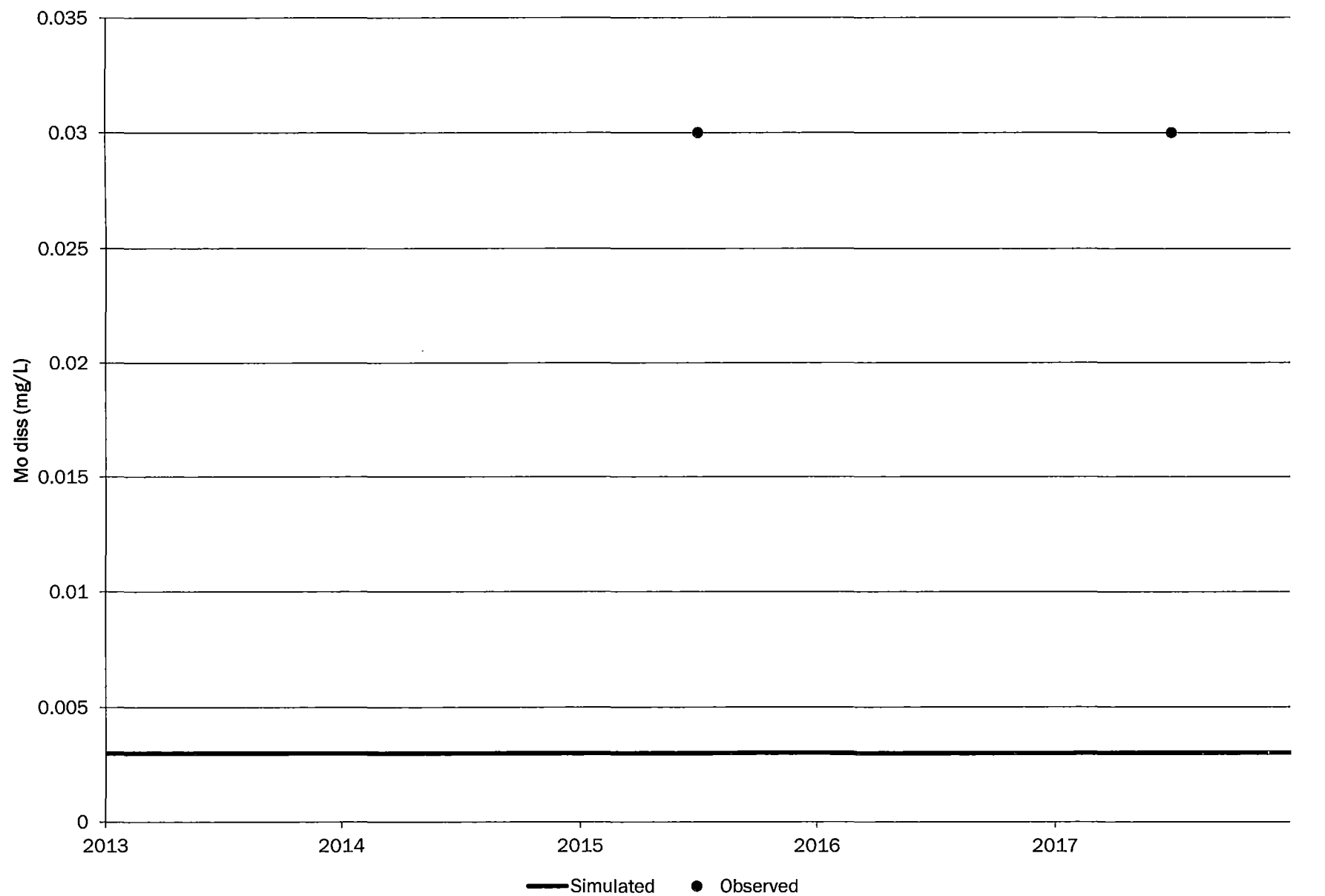
CW36-LC



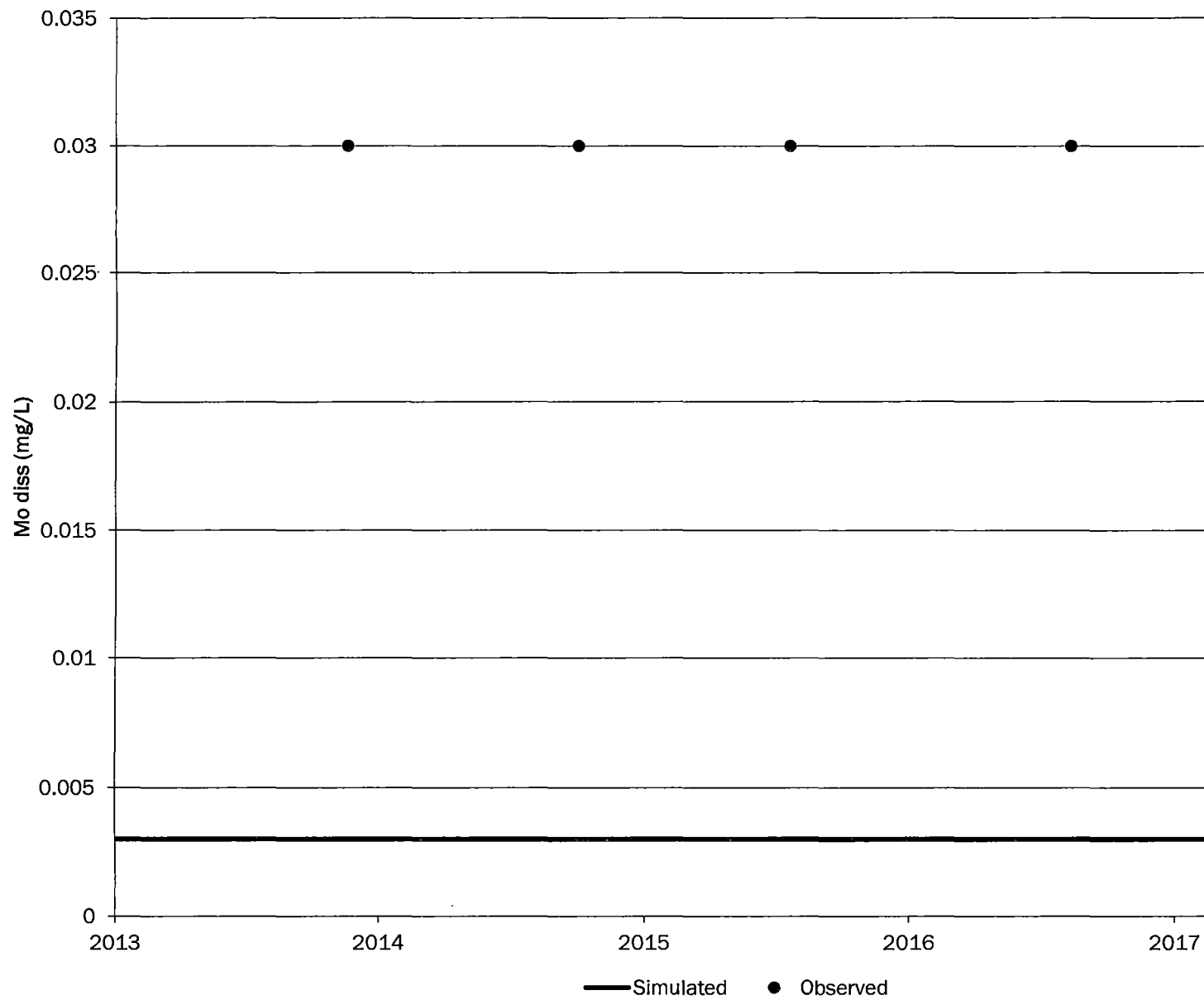
CW37-LC



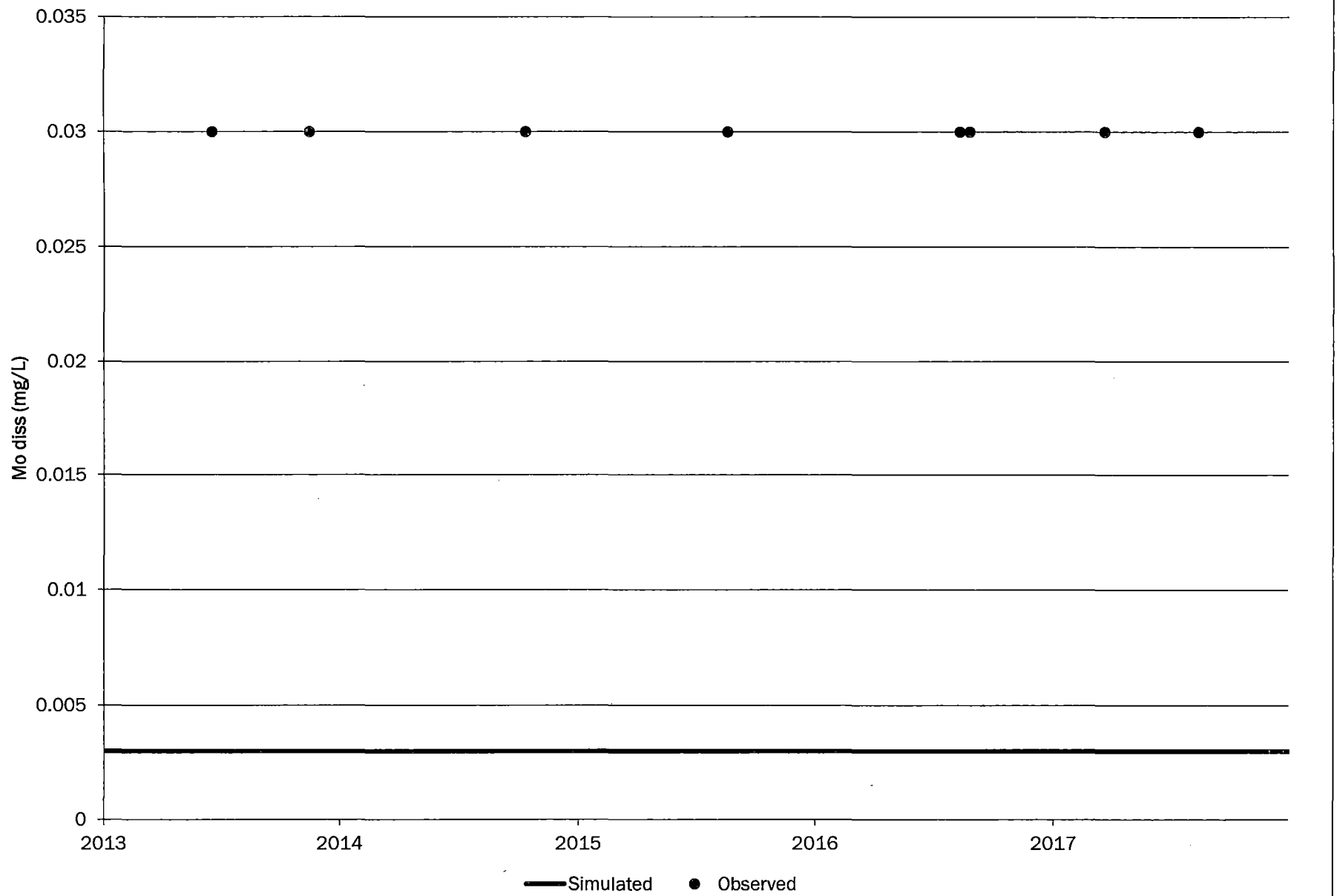
CW40-UC



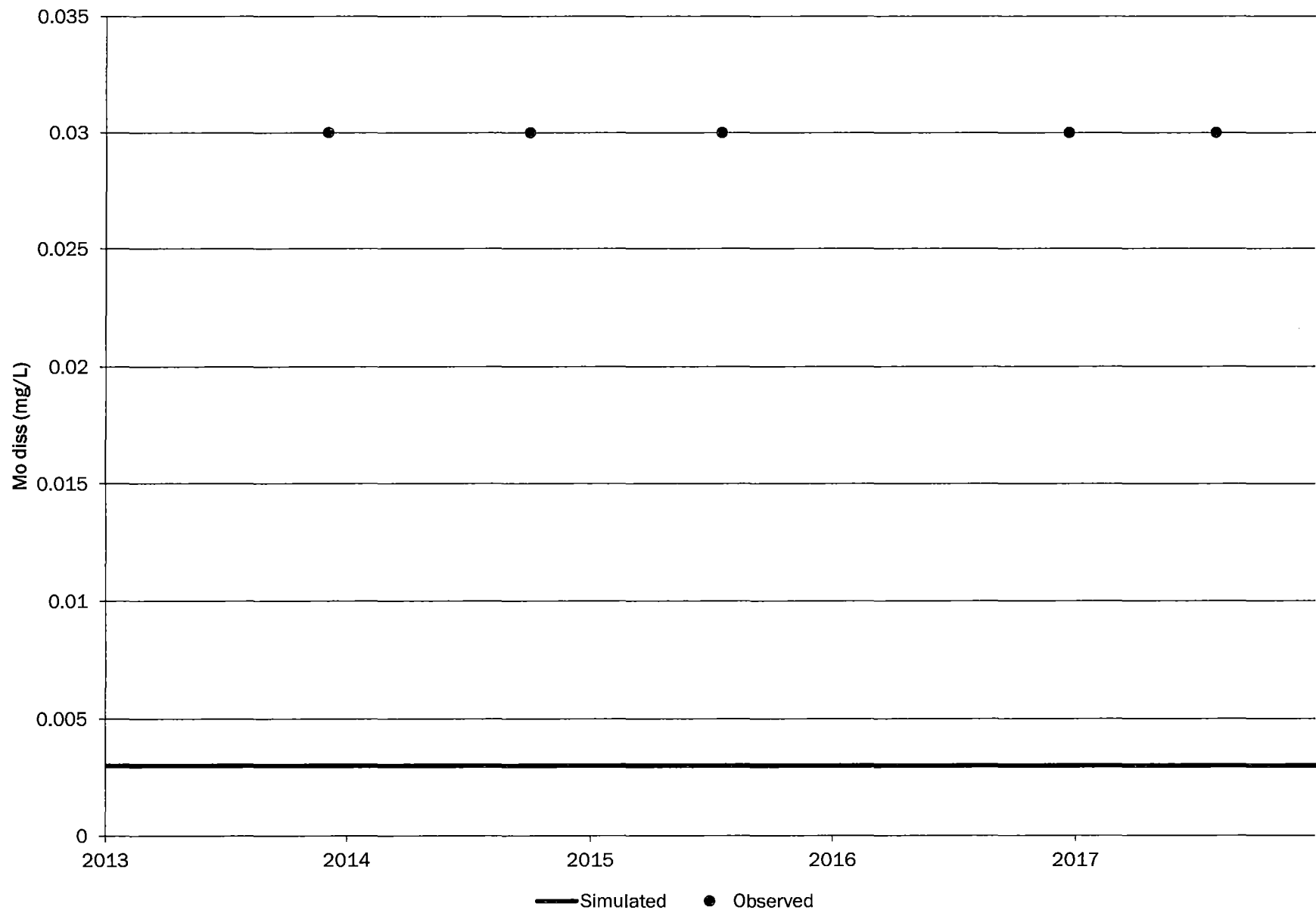
CW41-LC



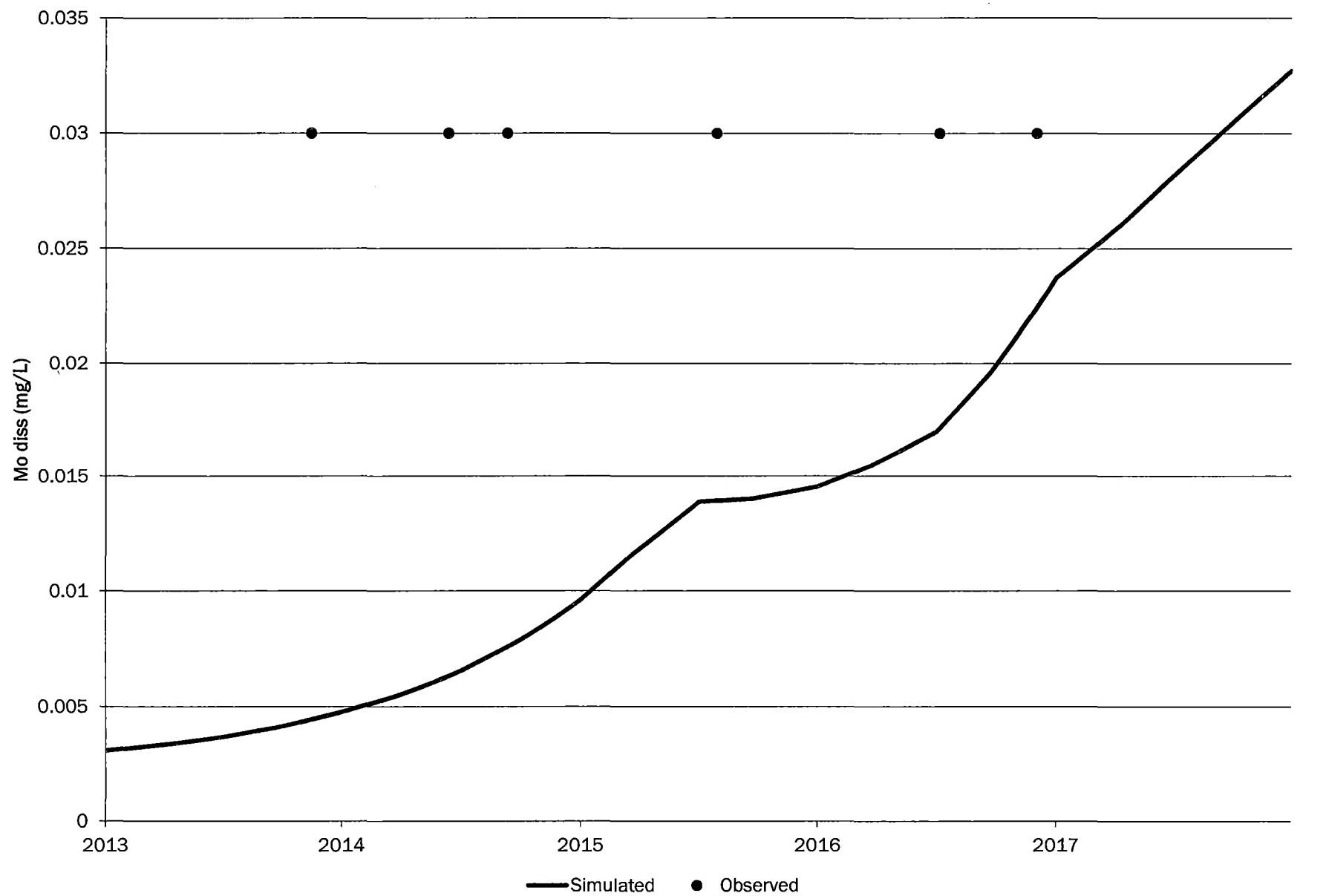
CW42-LC



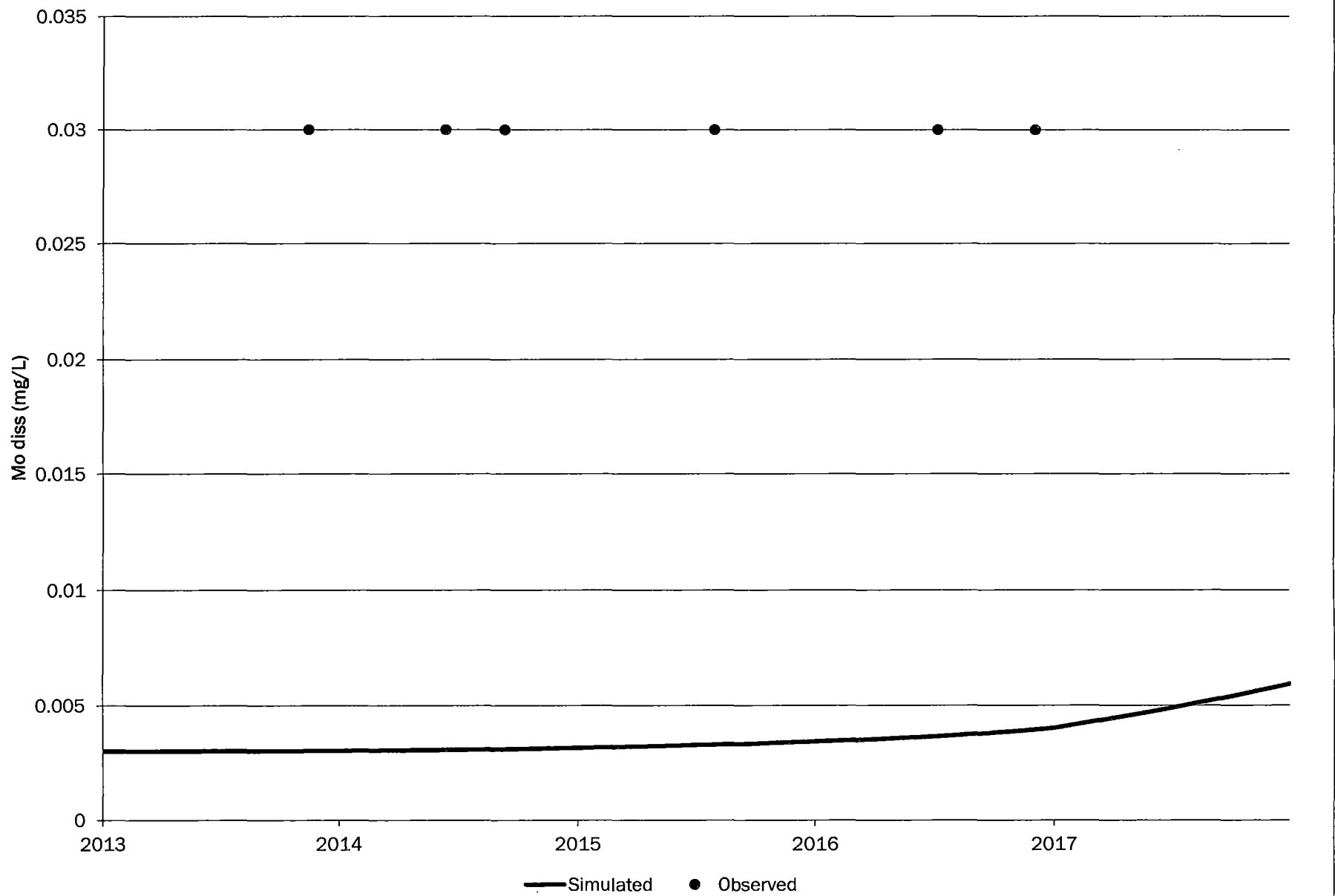
CW43-LC



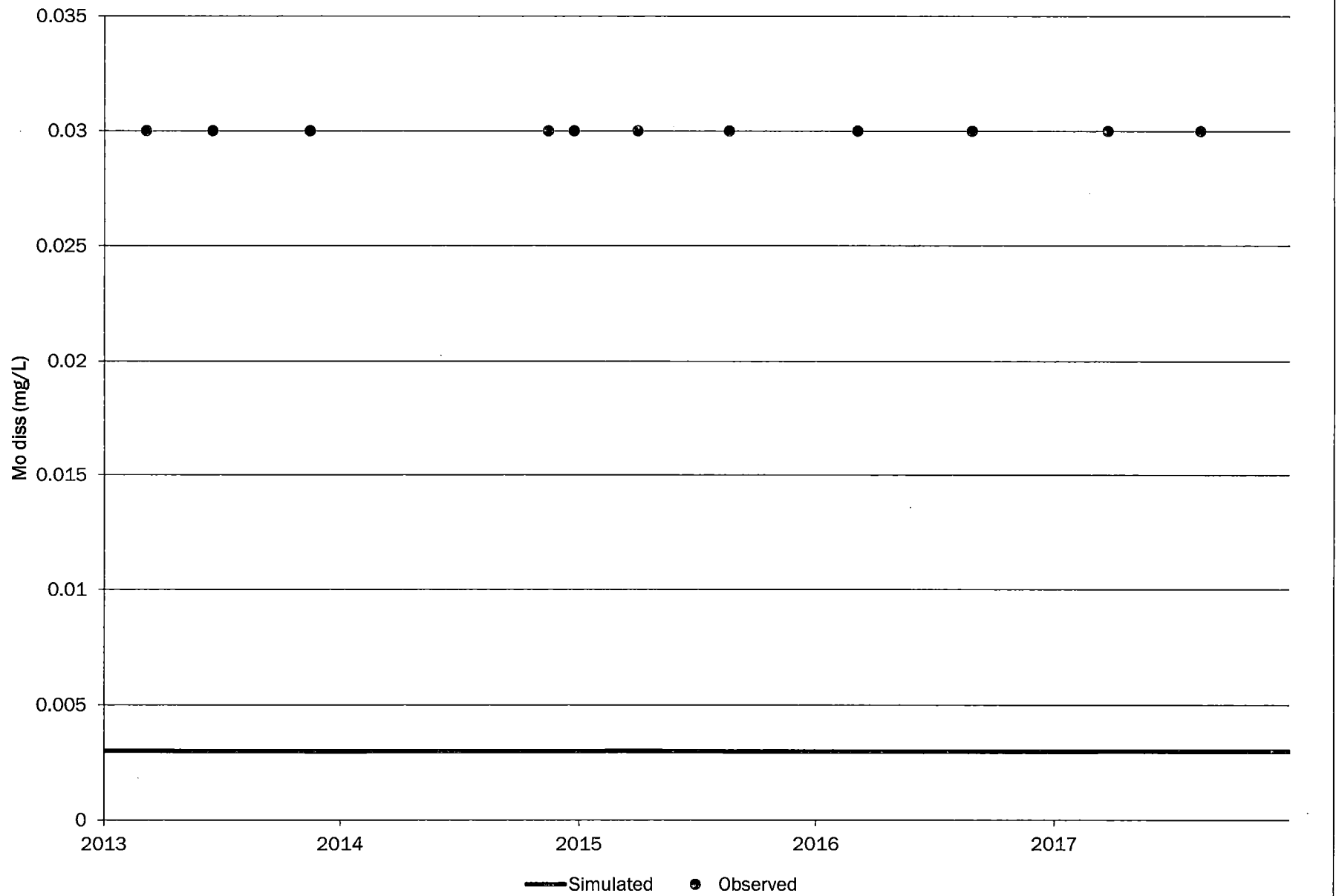
CW44-AI



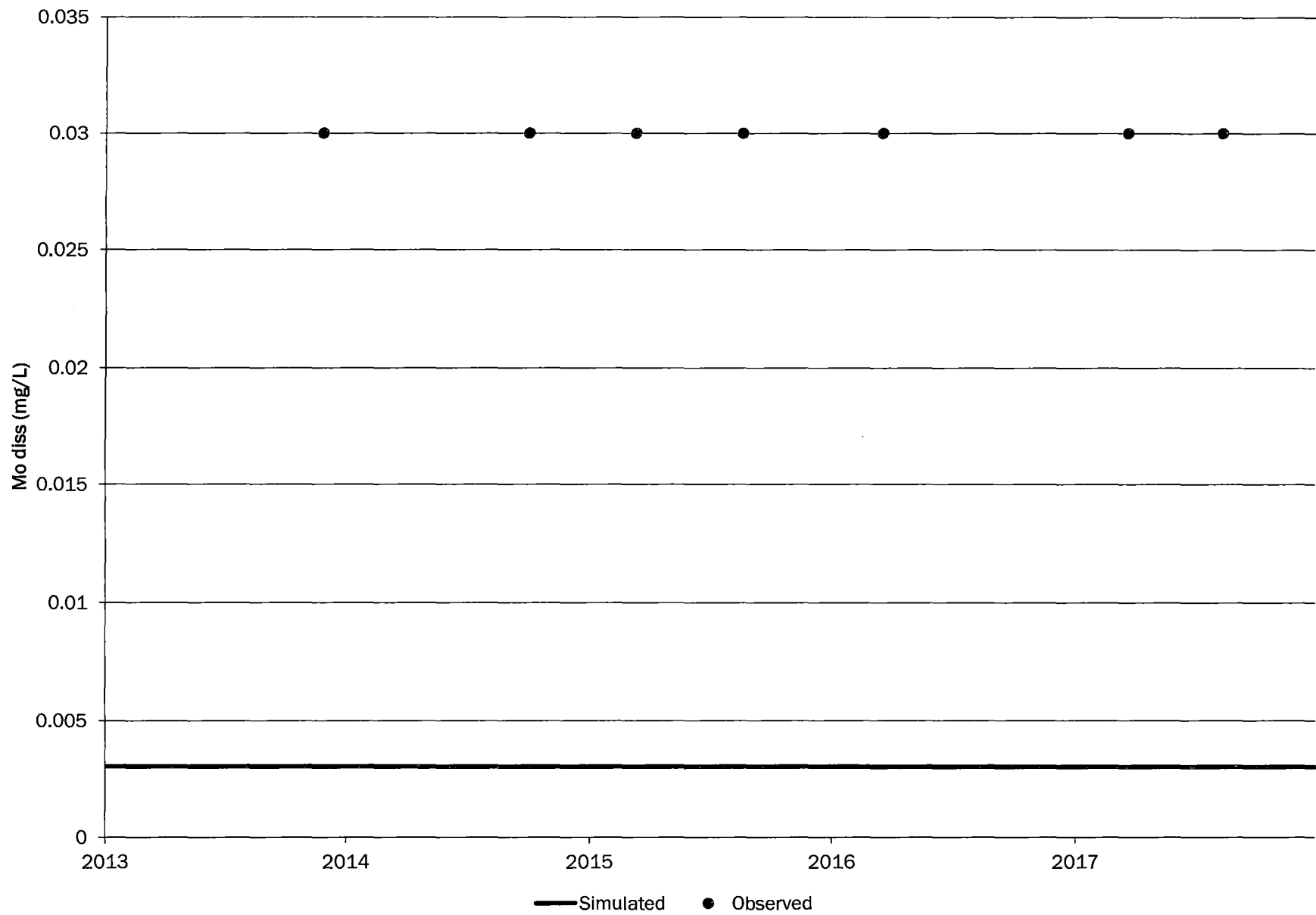
CW44-MC



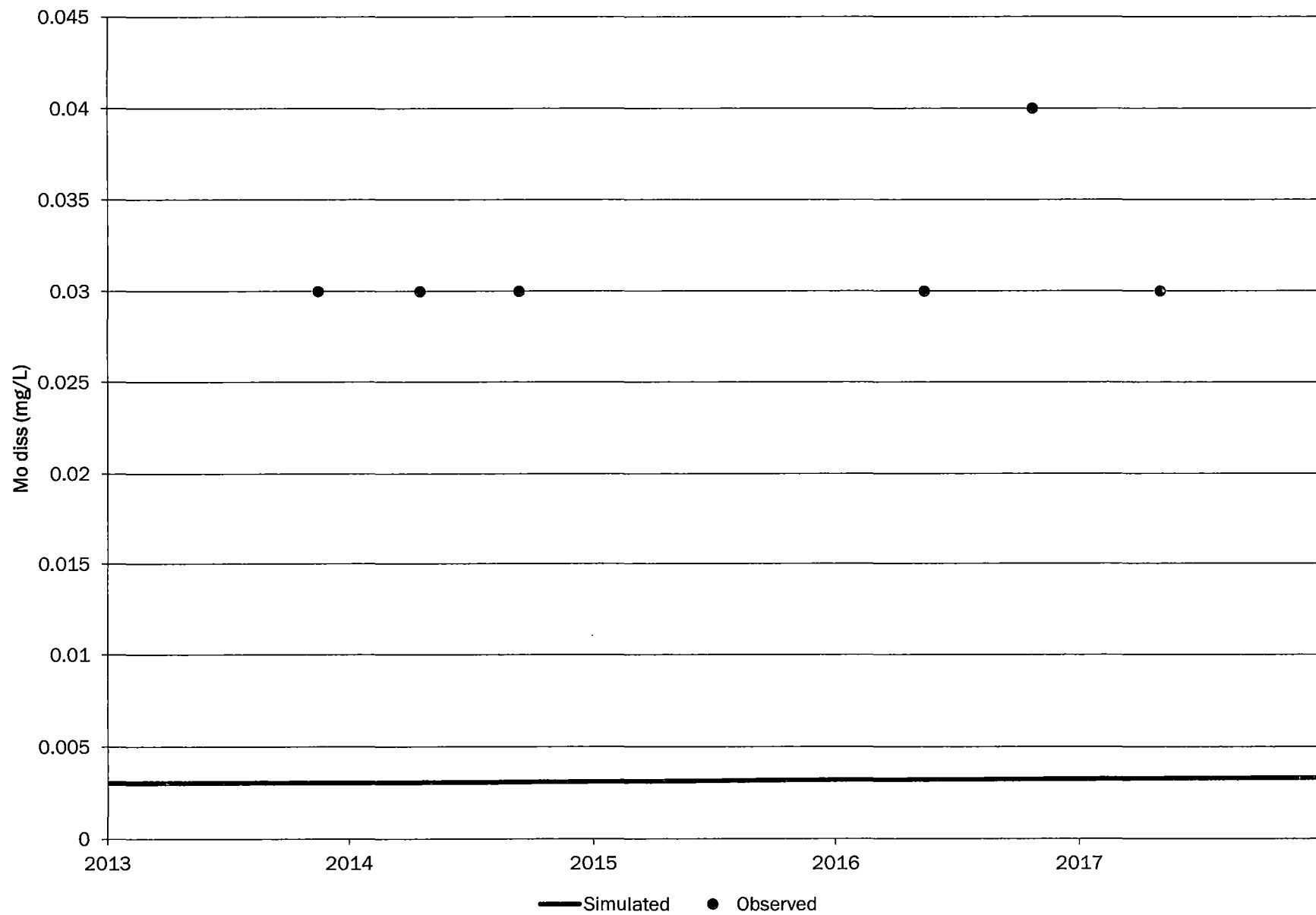
CW45-MC



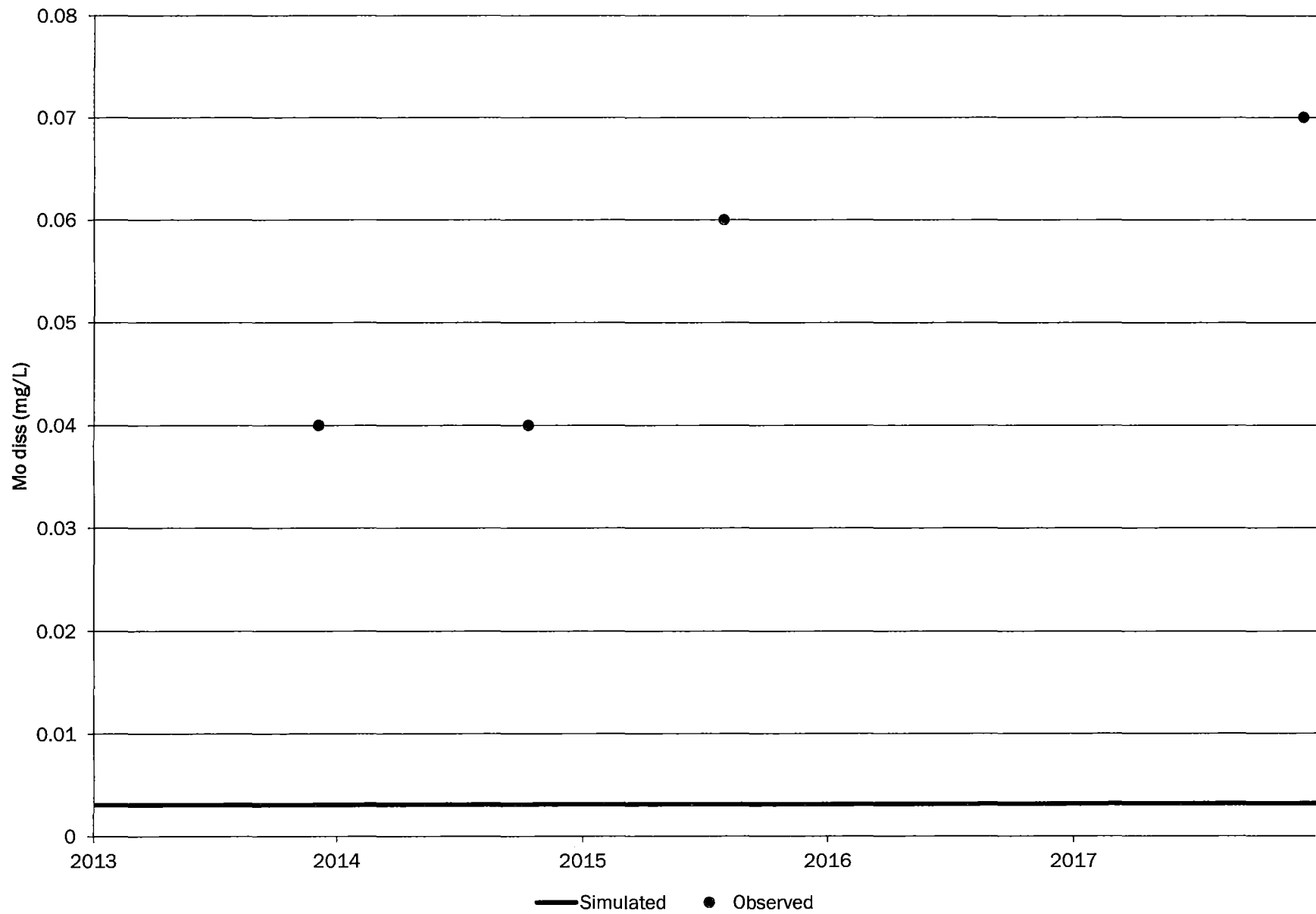
CW50-UC



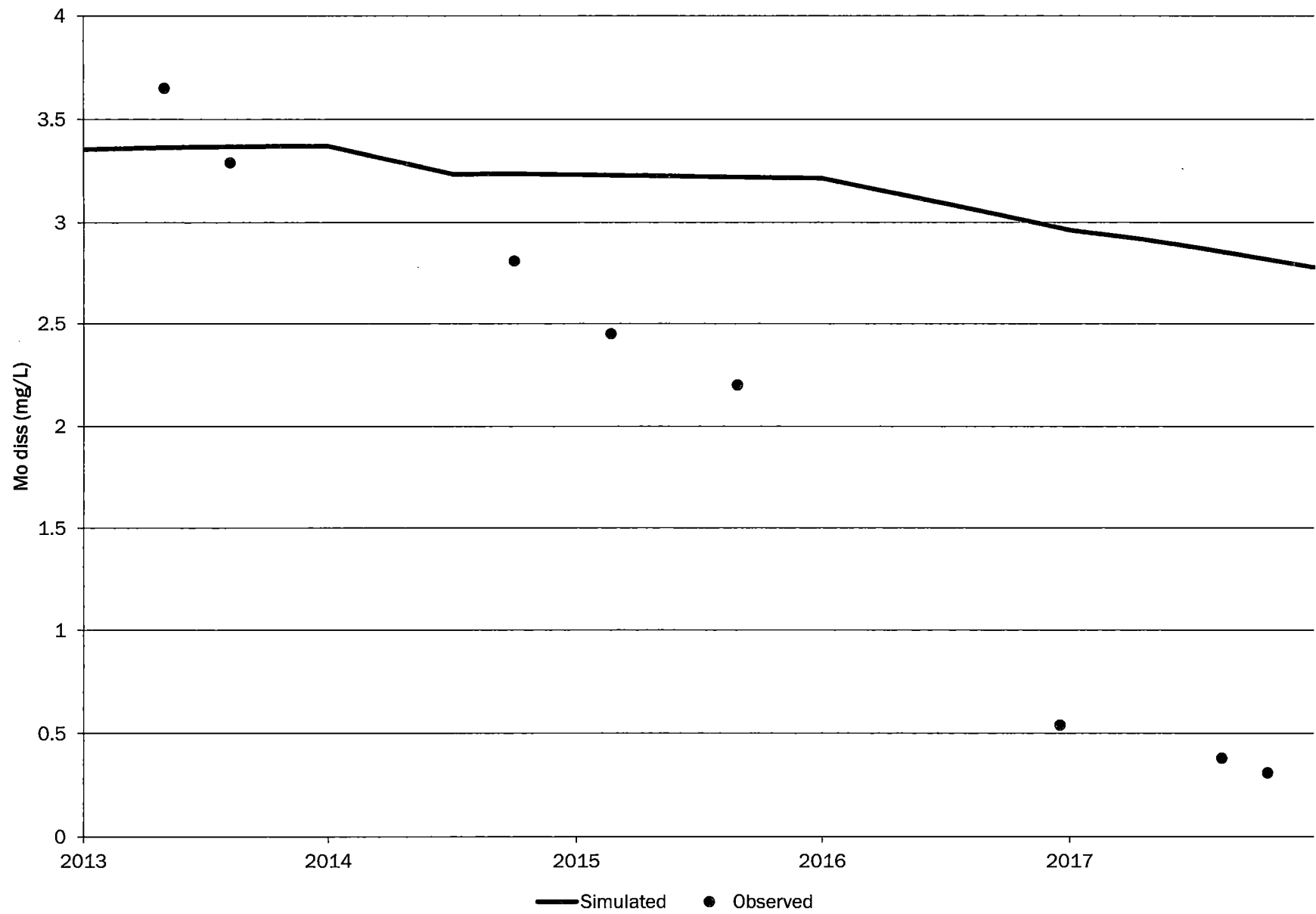
CW53-UC



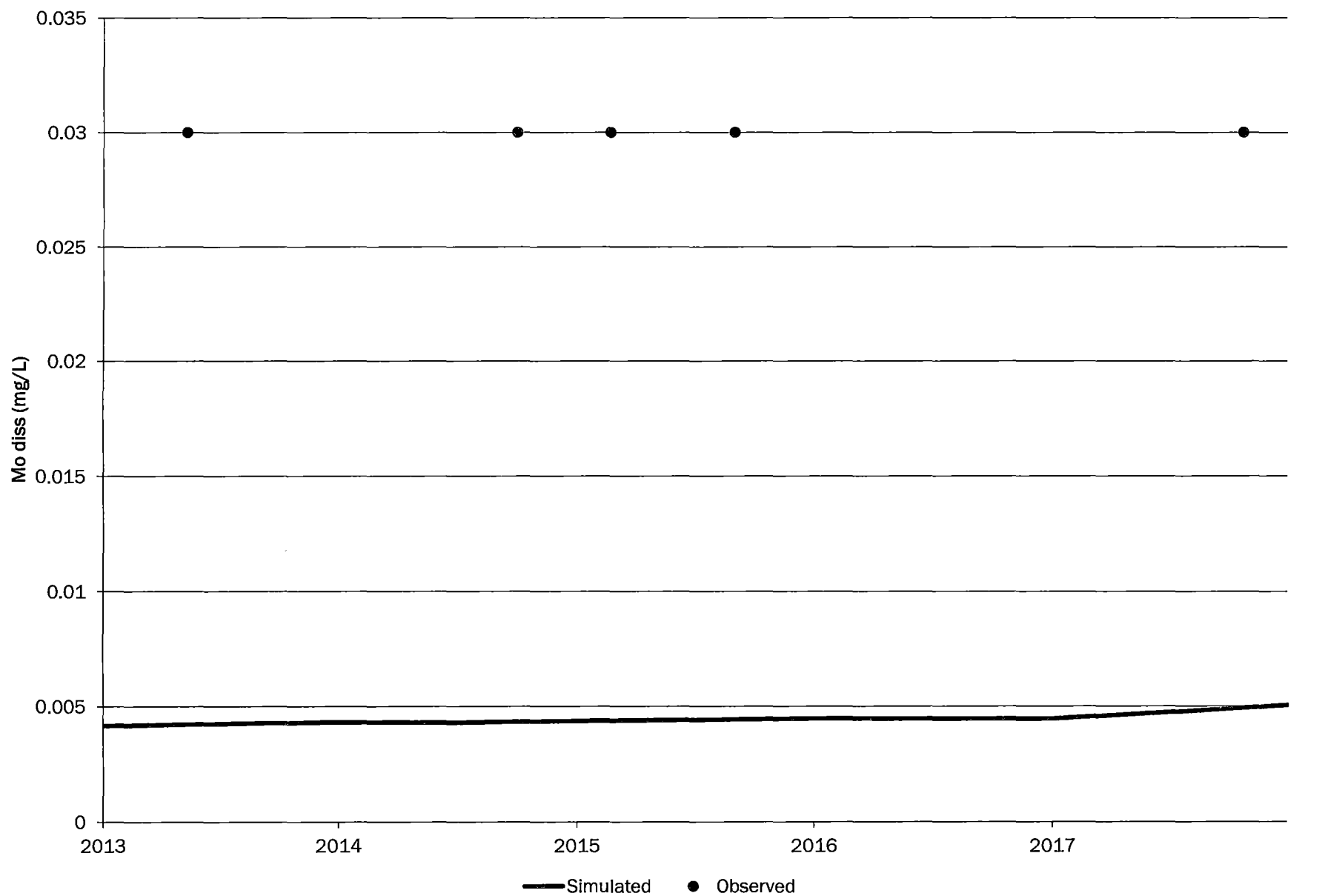
CW55-MC



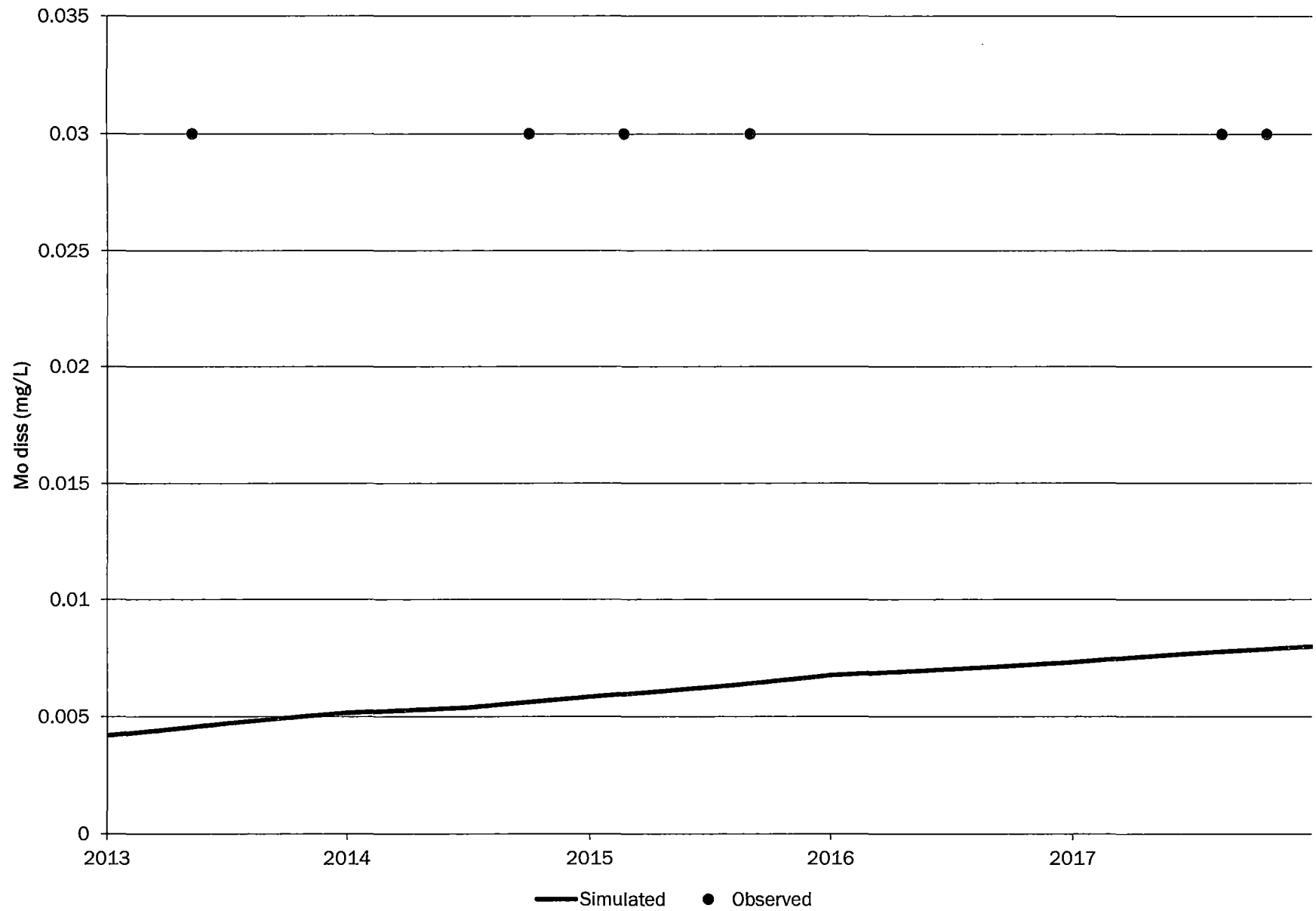
CW56-MC



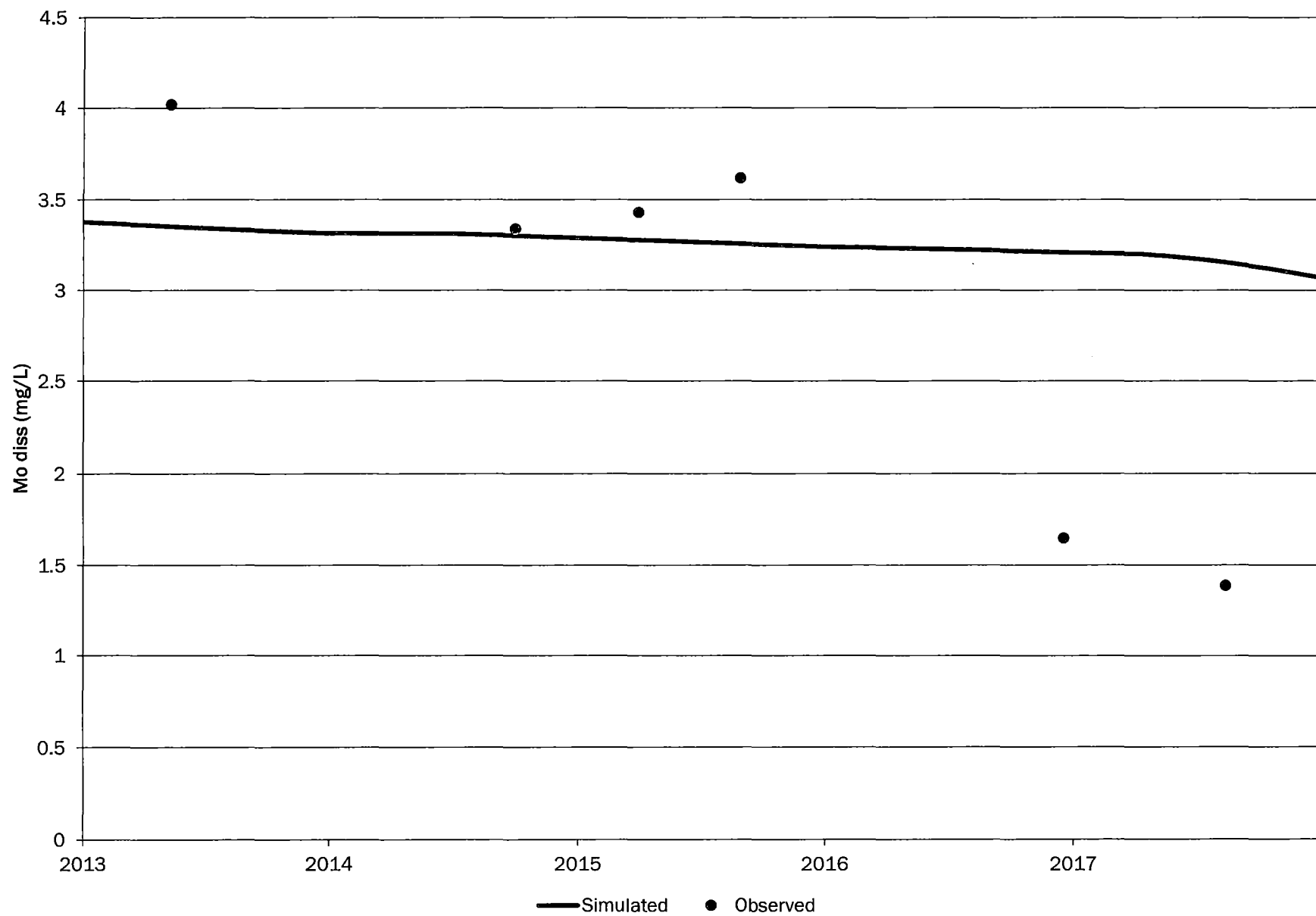
CW57-MC



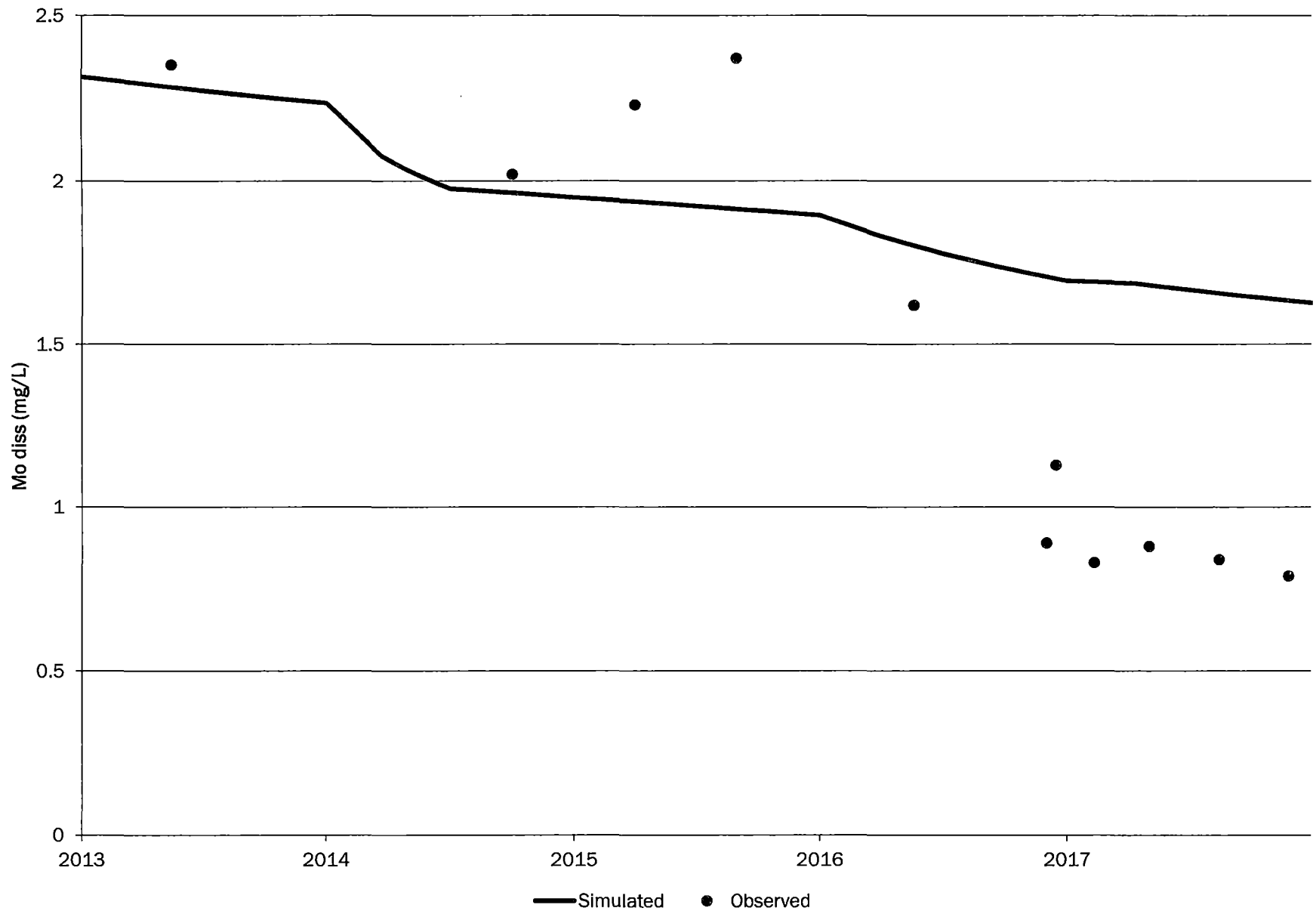
CW60-MC



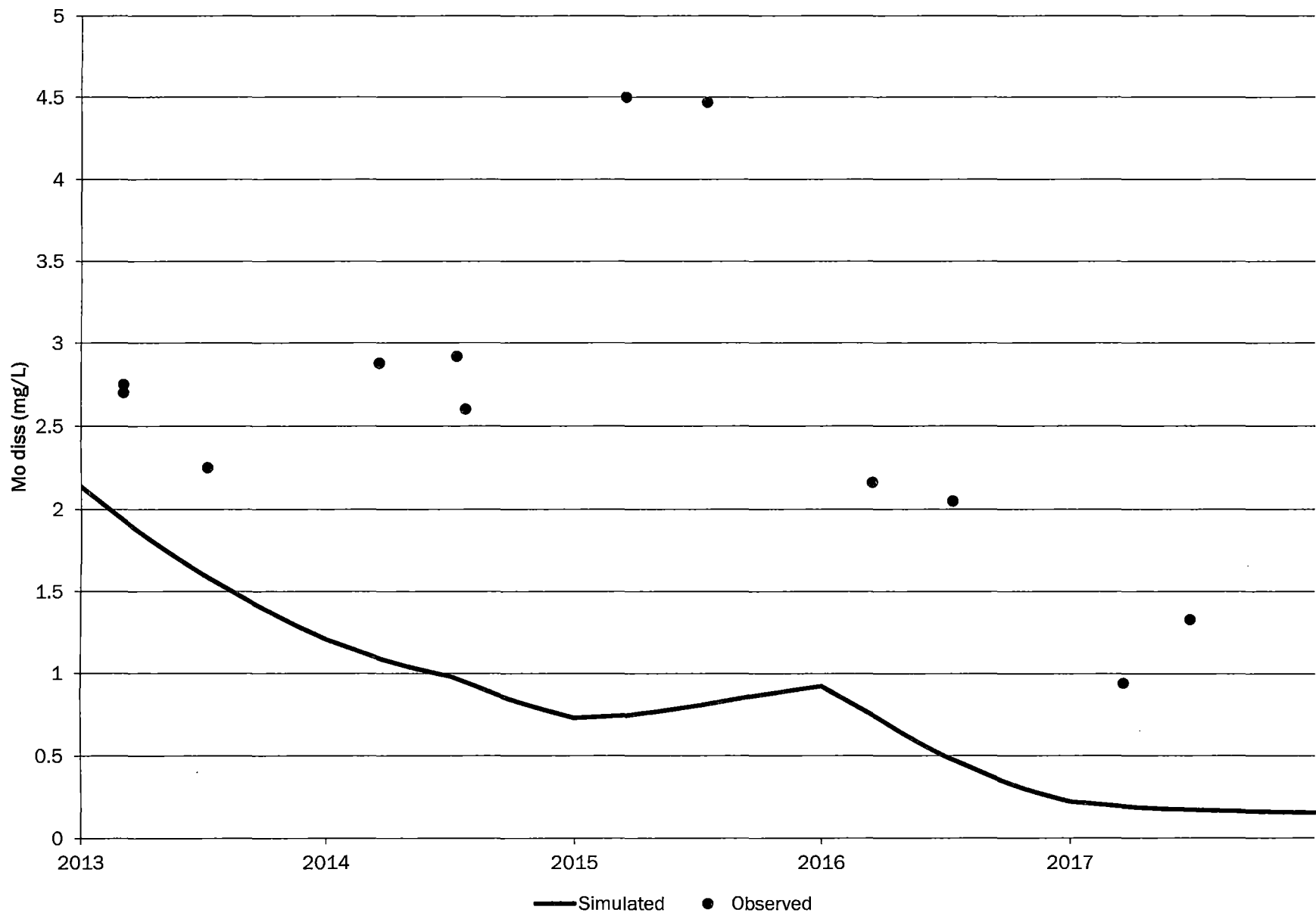
CW61-MC



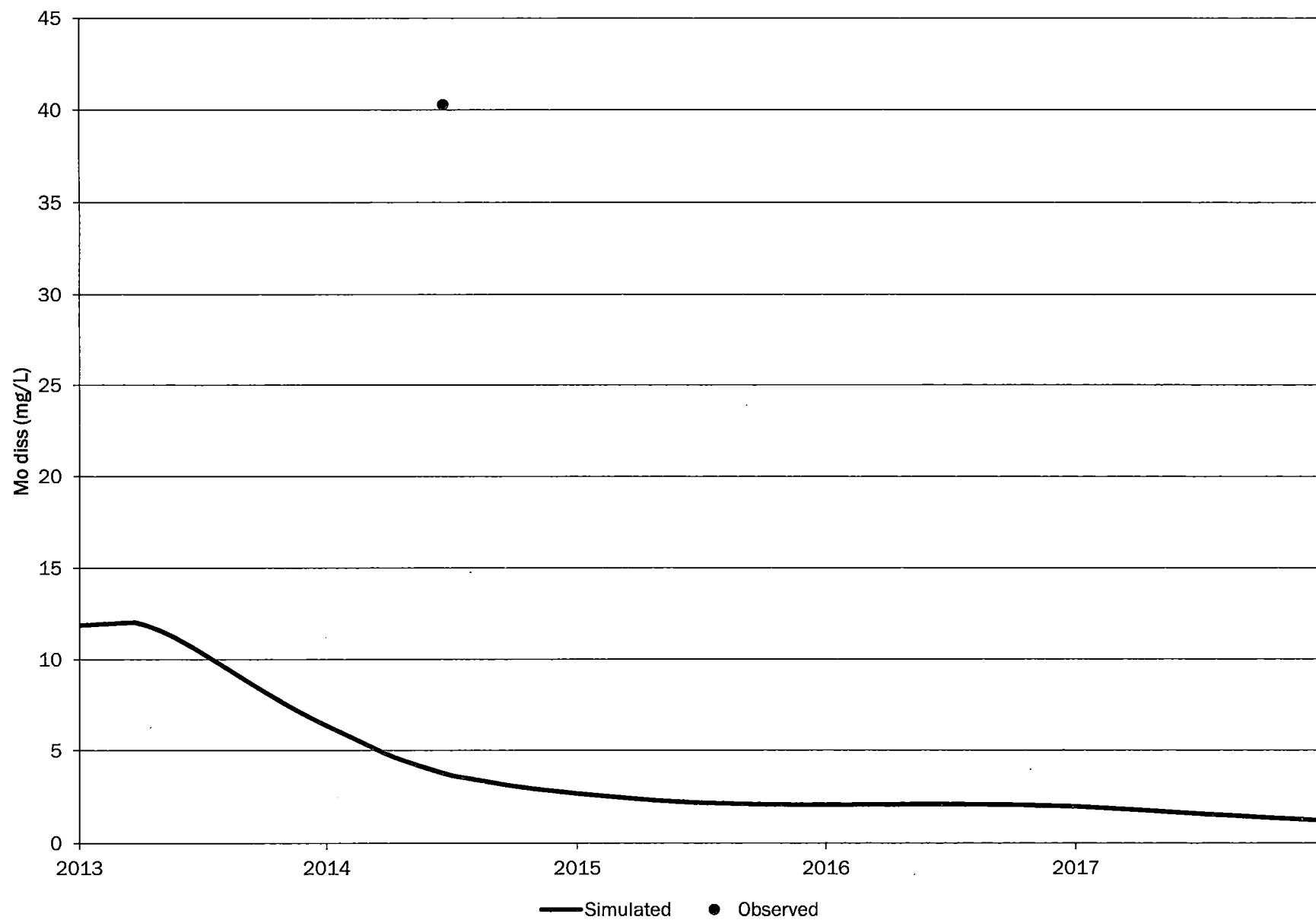
CW62-MC



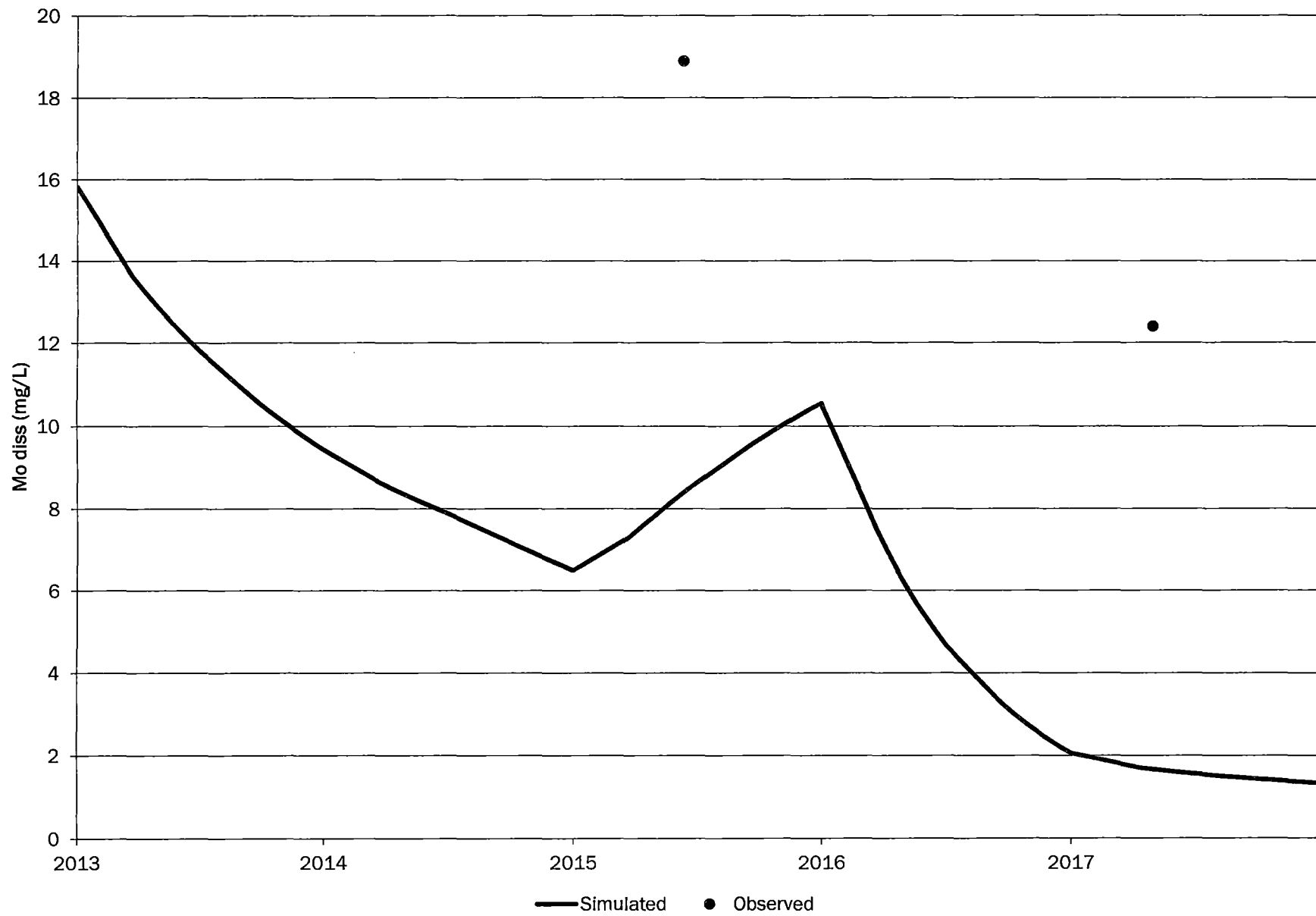
D1-AI



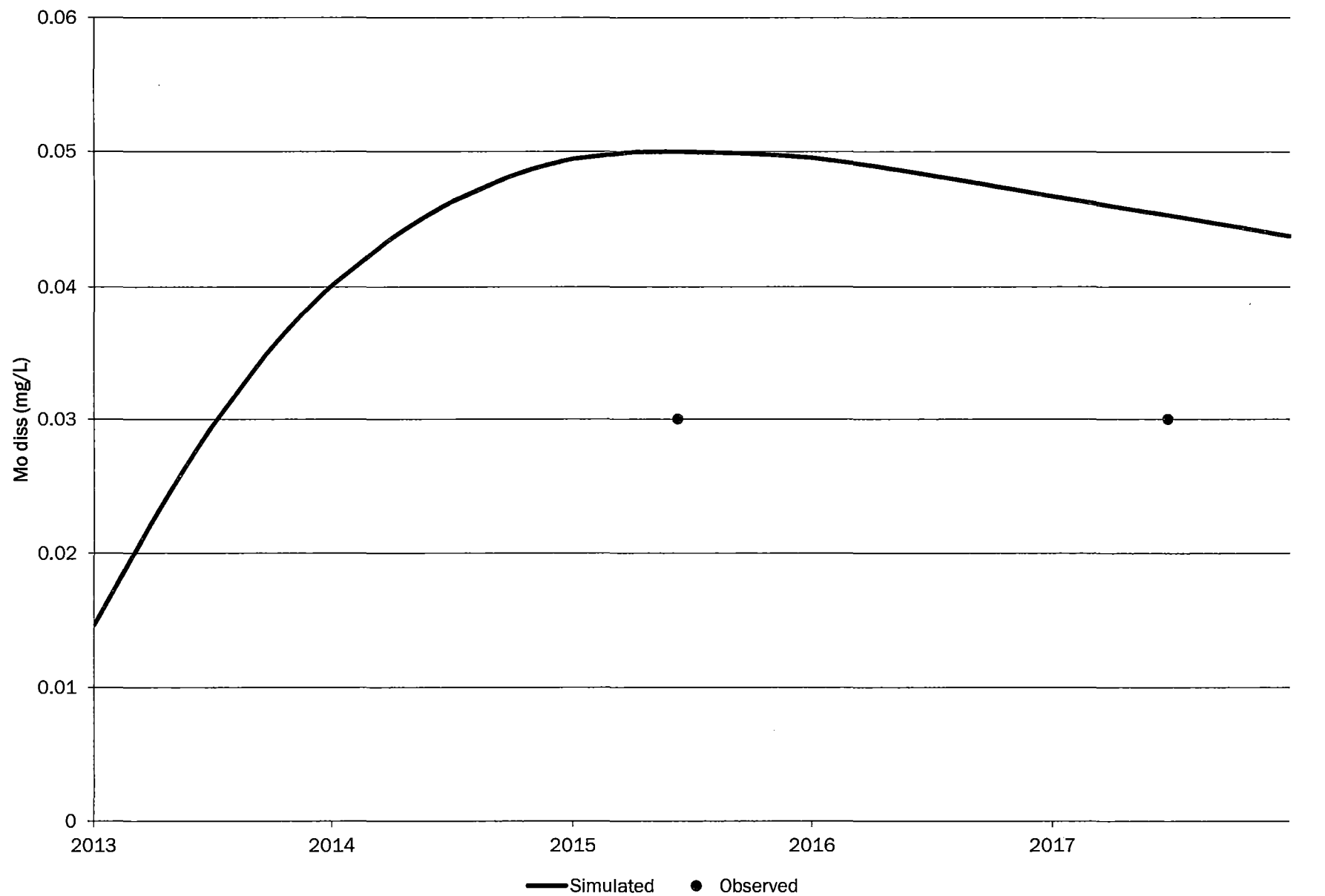
D2-AI



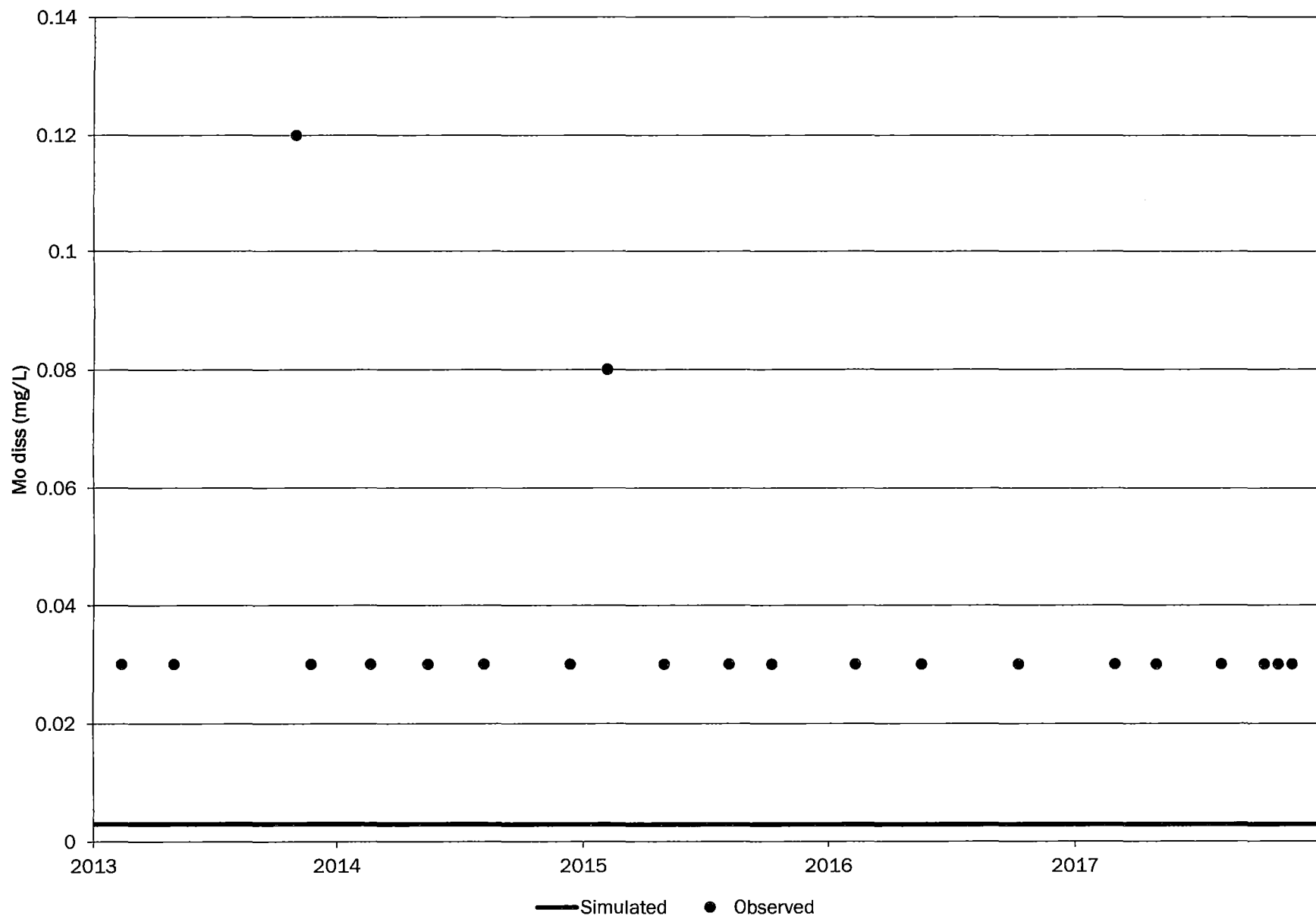
DA3-AI

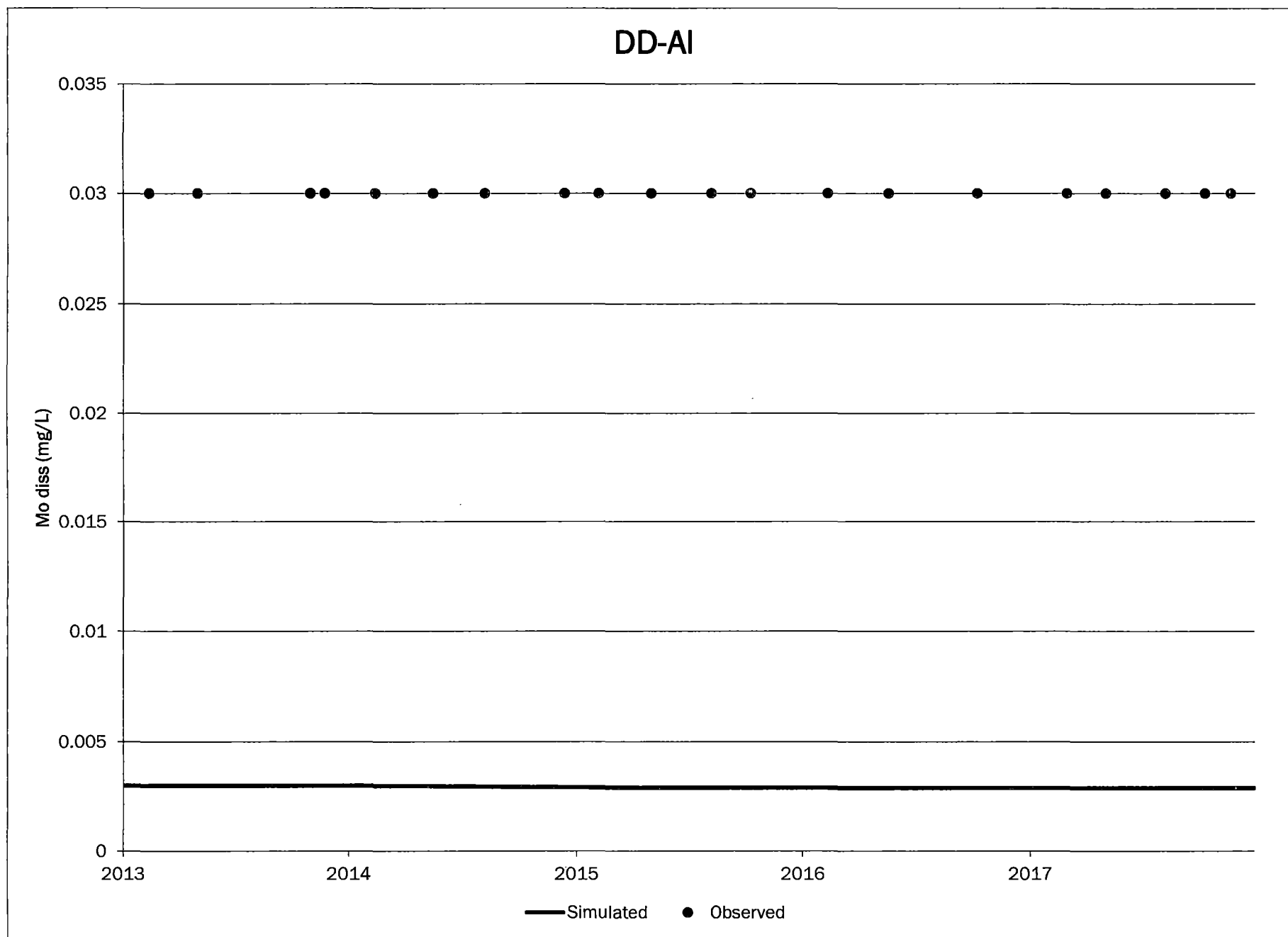


DC-AI

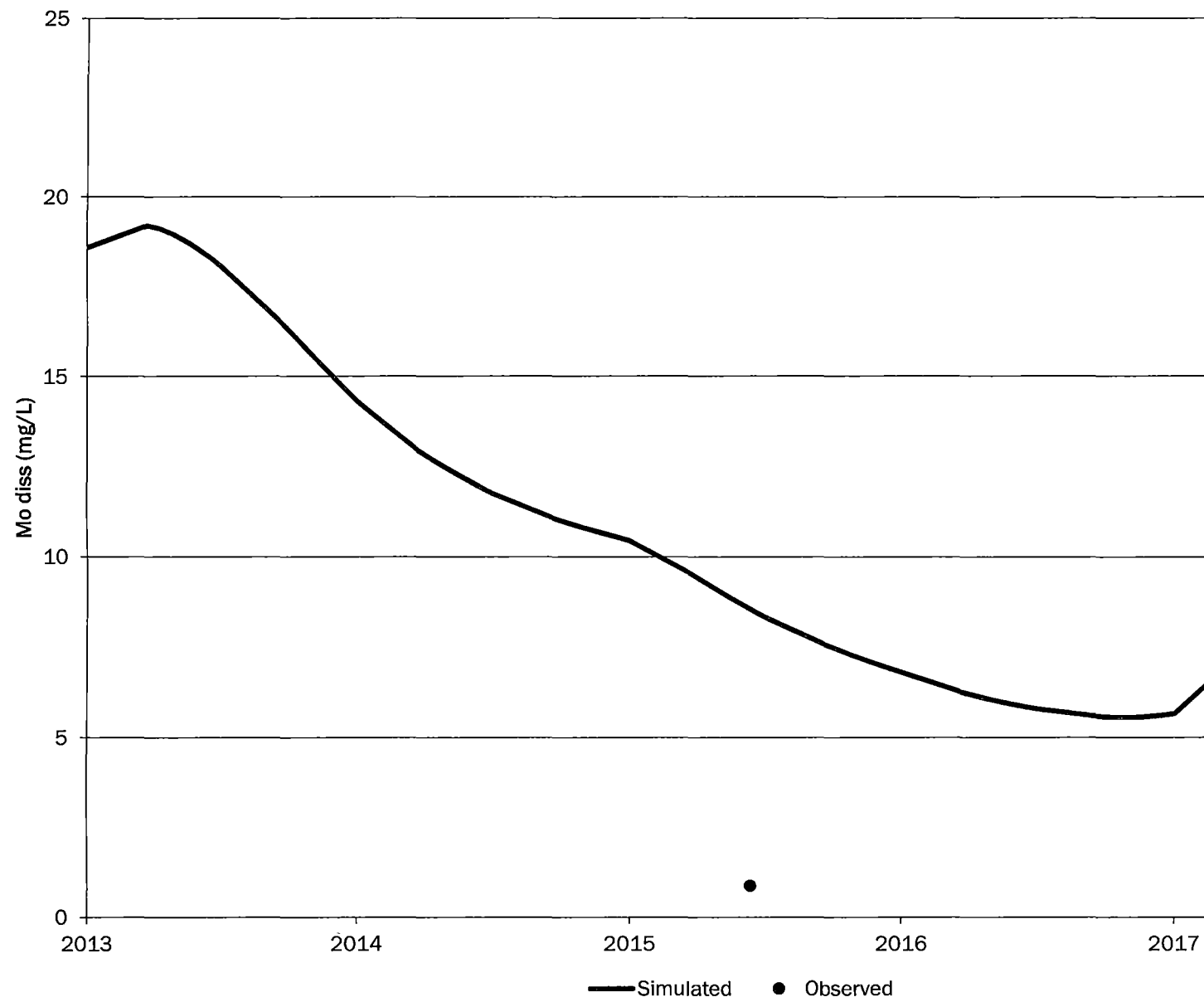


DD2-AI

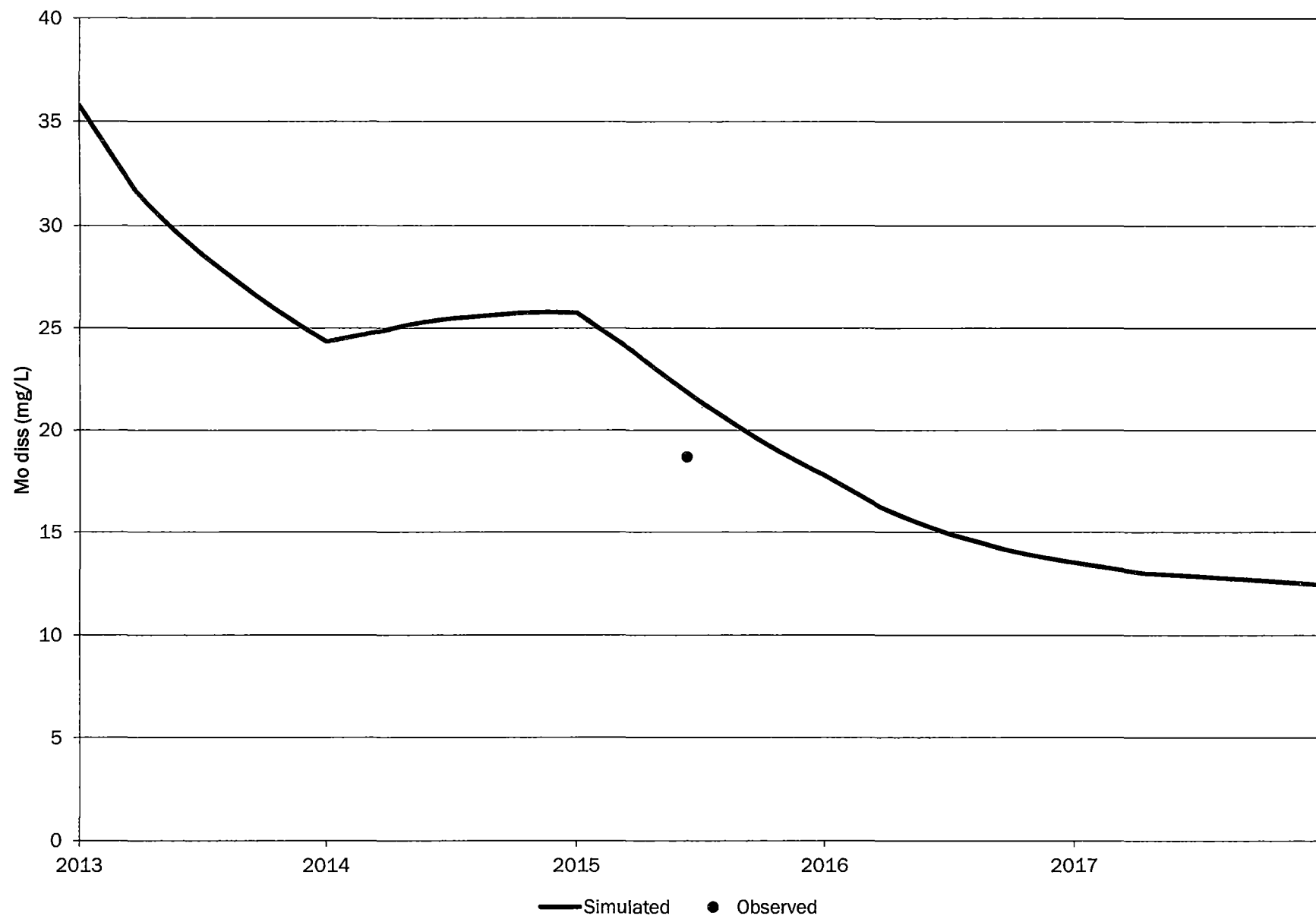




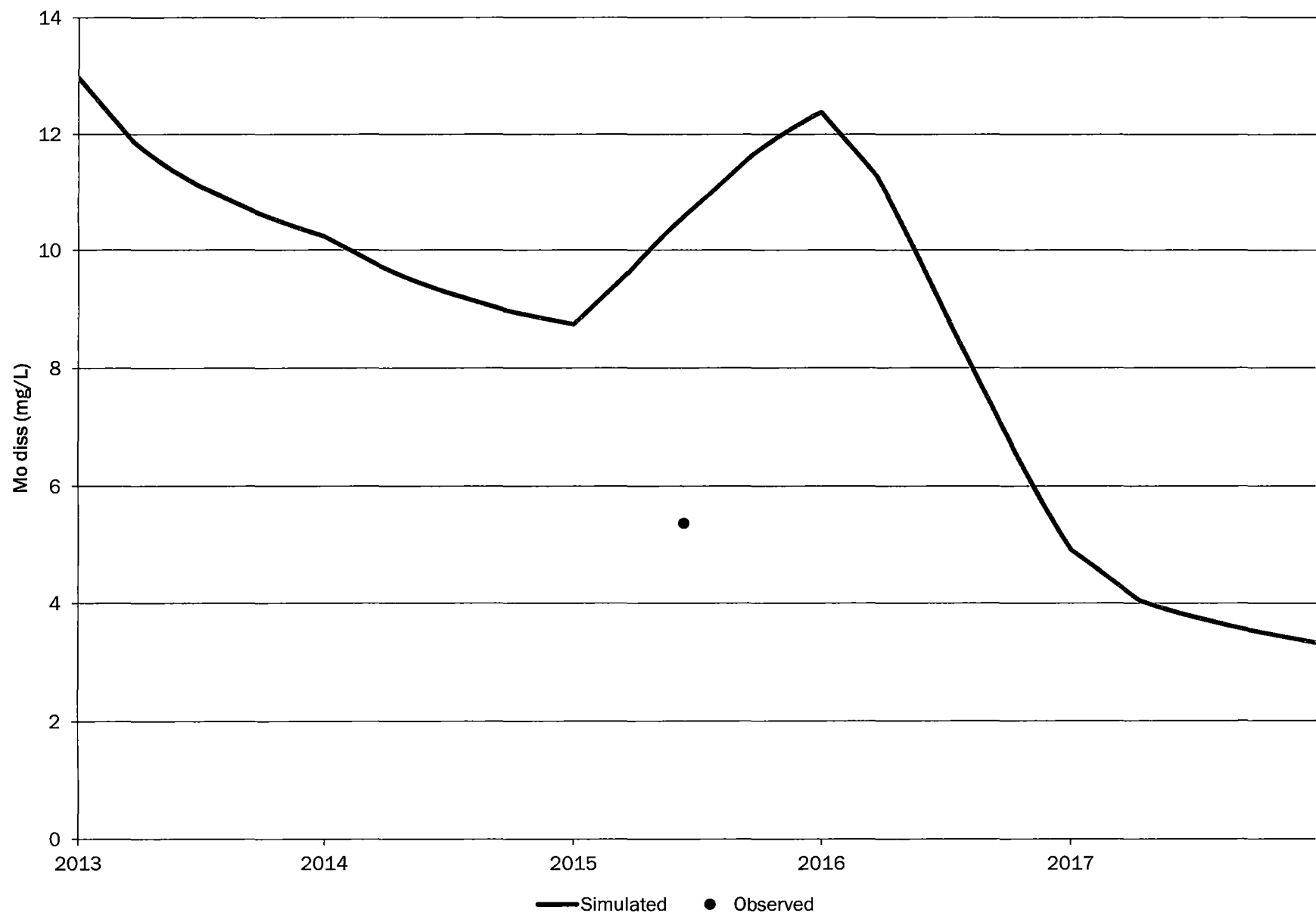
DQ-AI



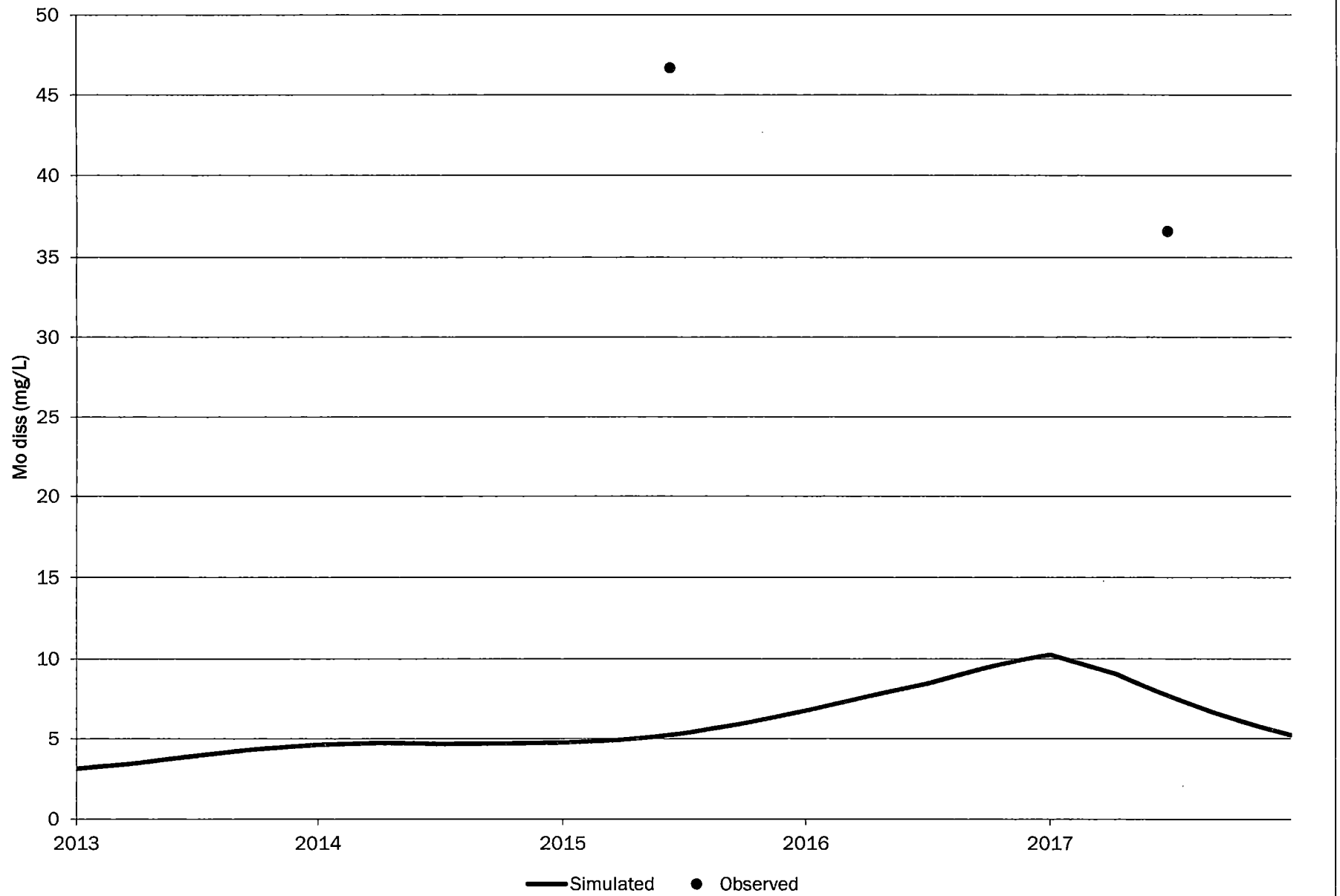
DR-AI



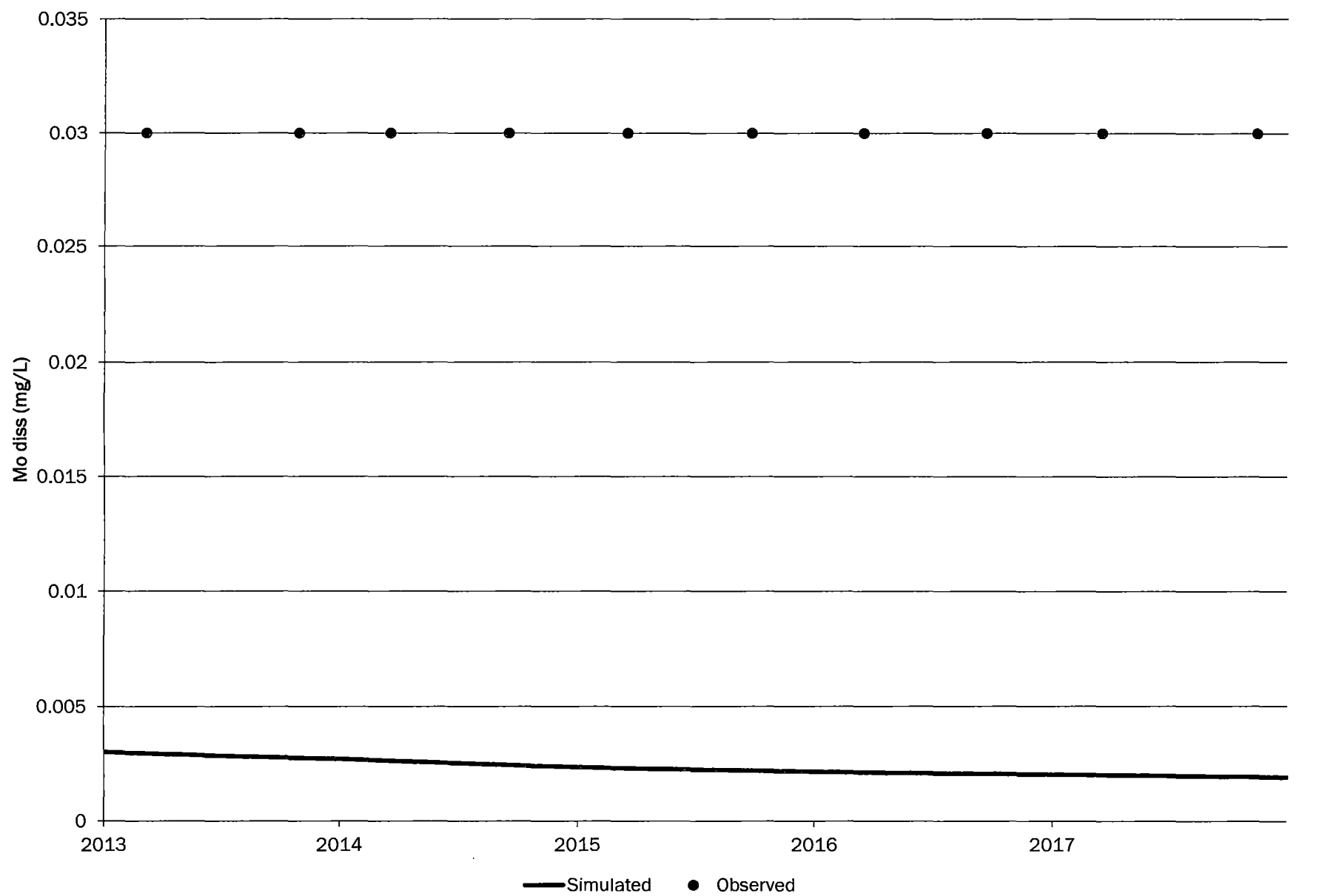
DT-AI



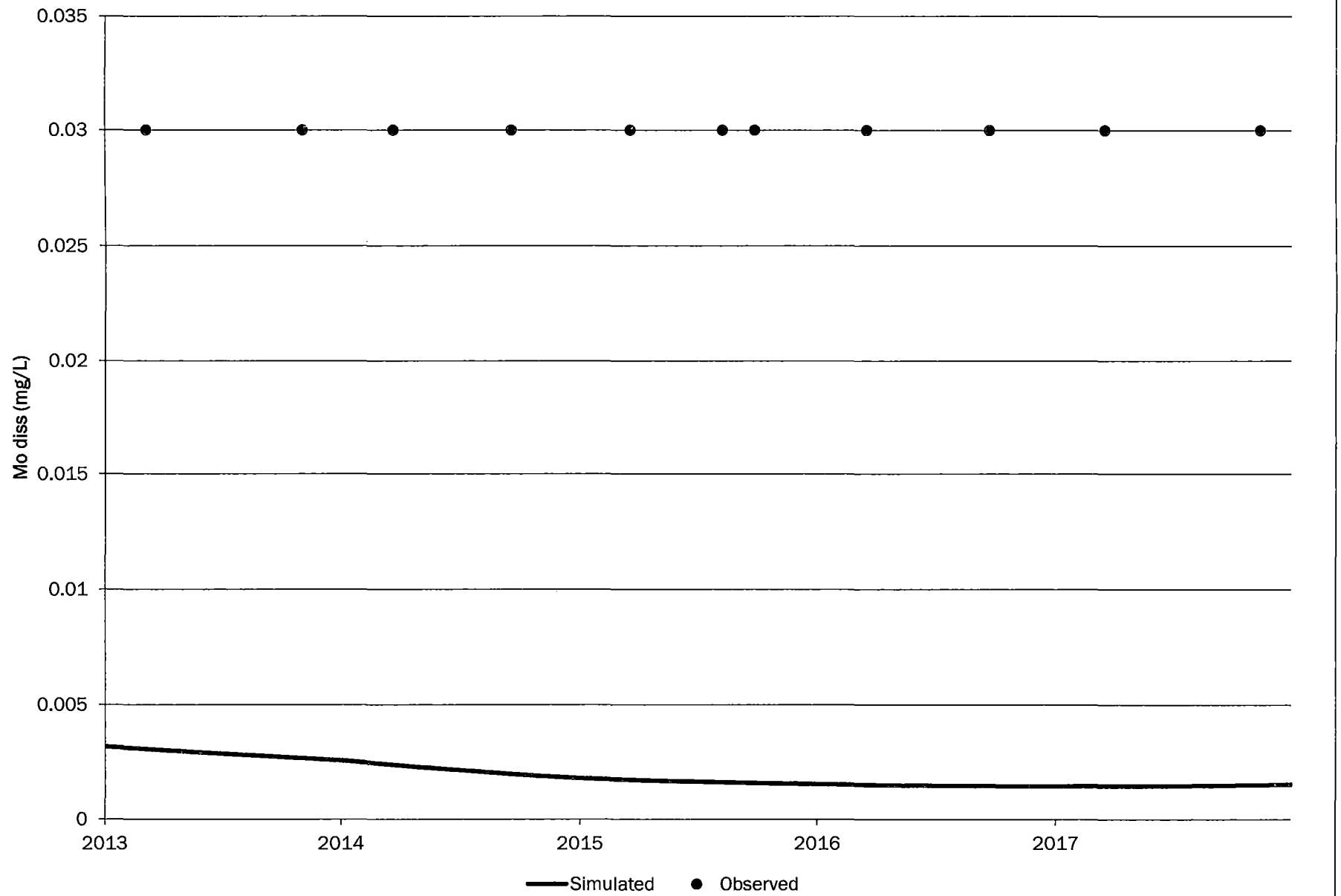
DZ-AI



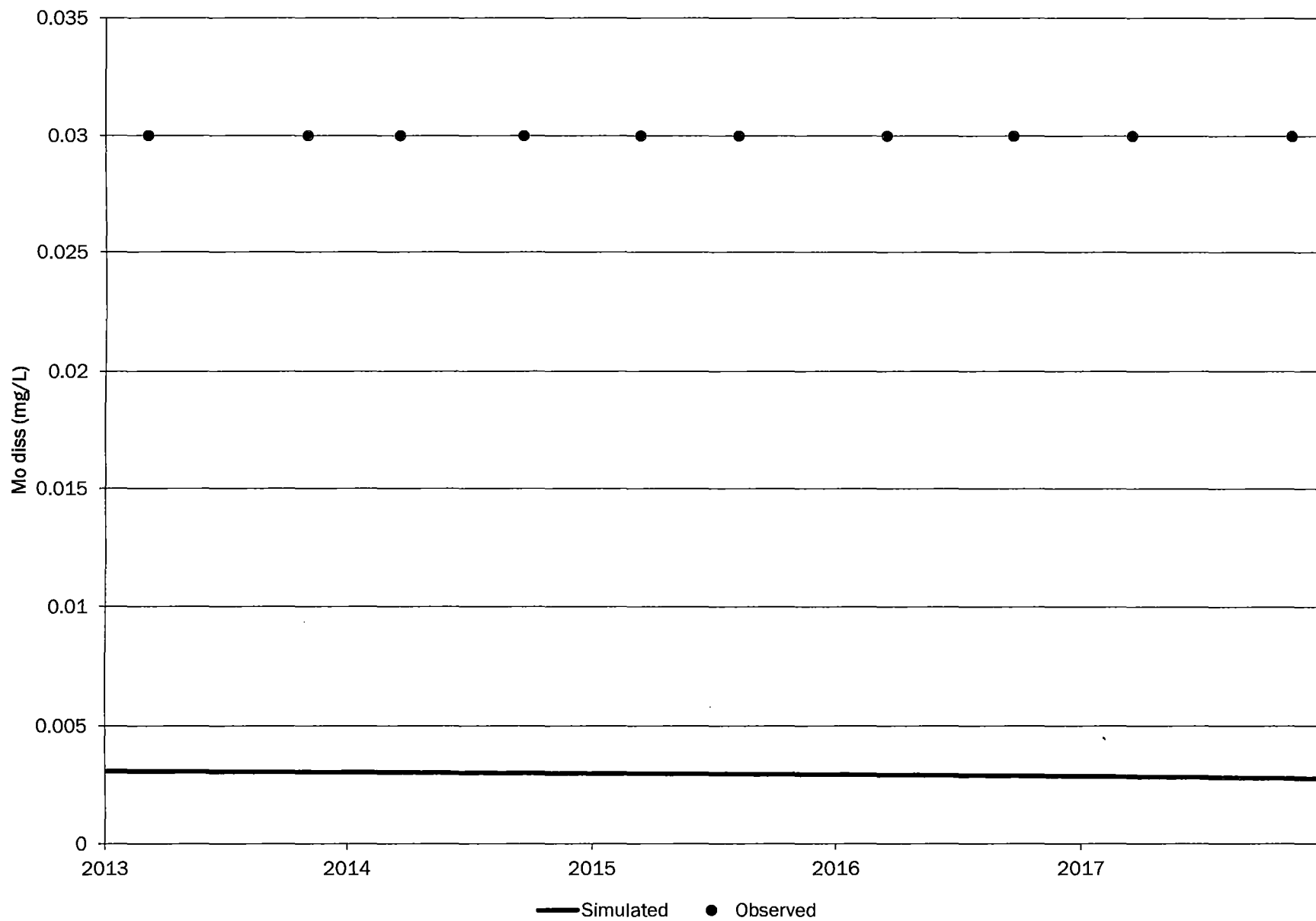
F-AI



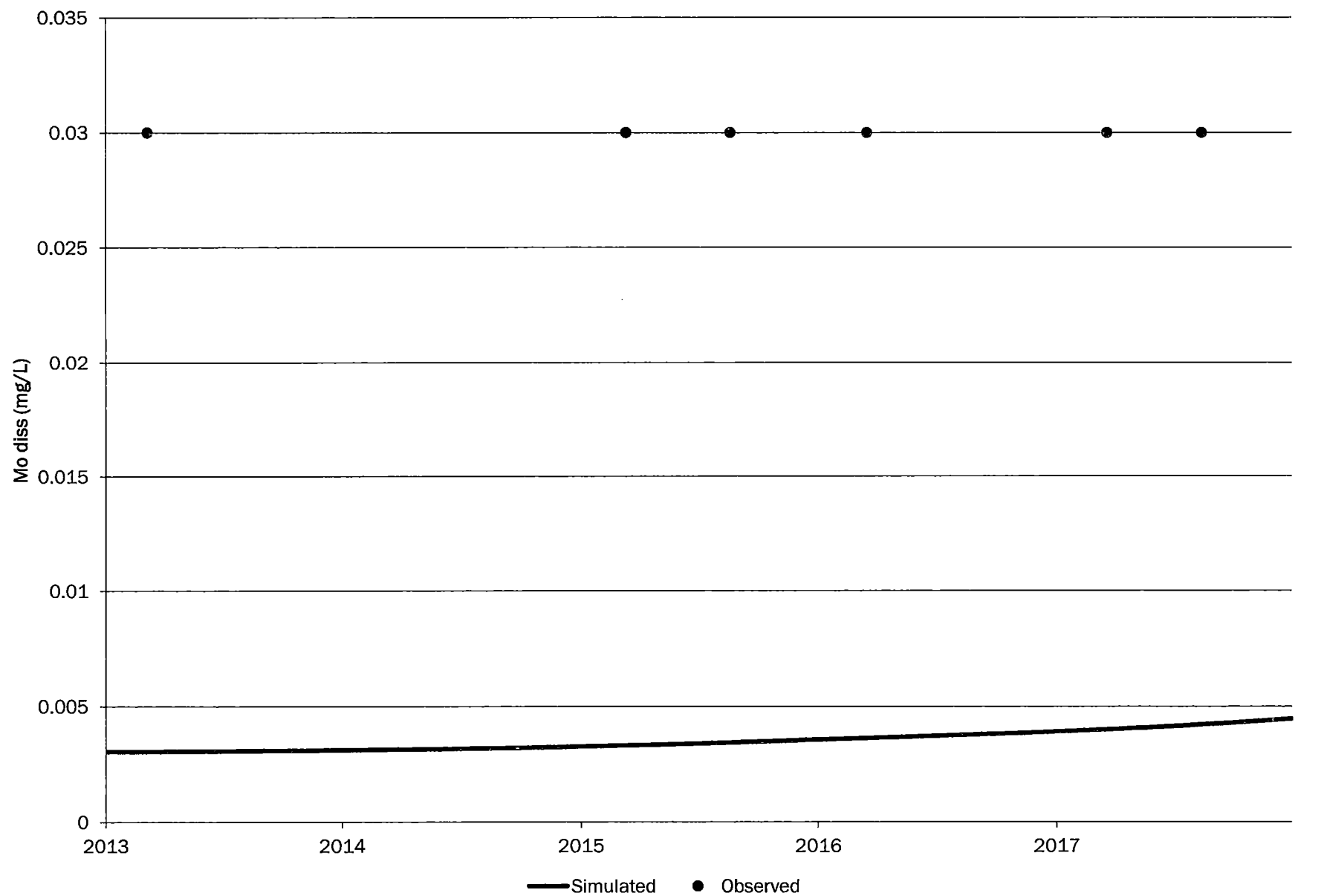
FB-AI



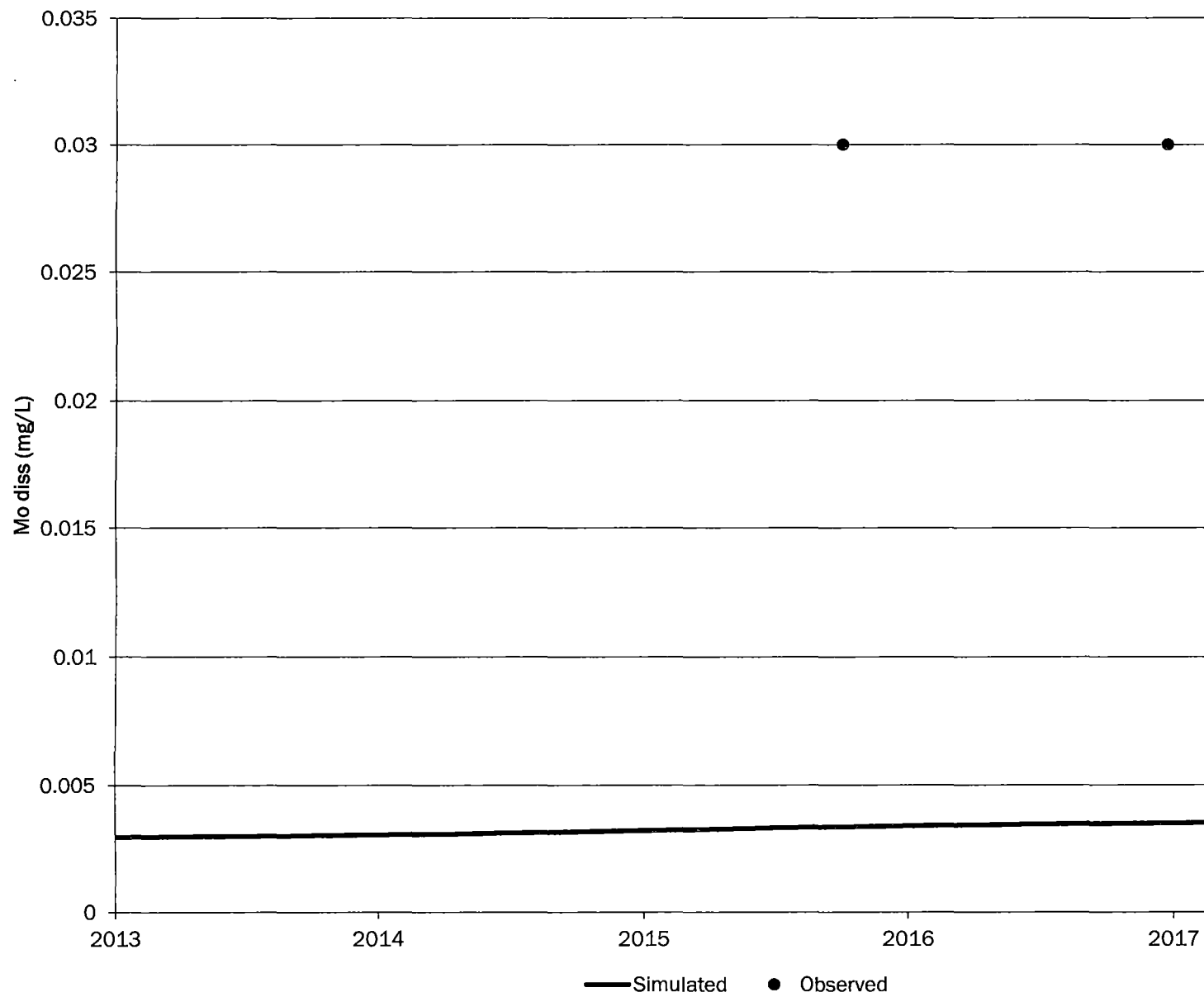
GH-AI



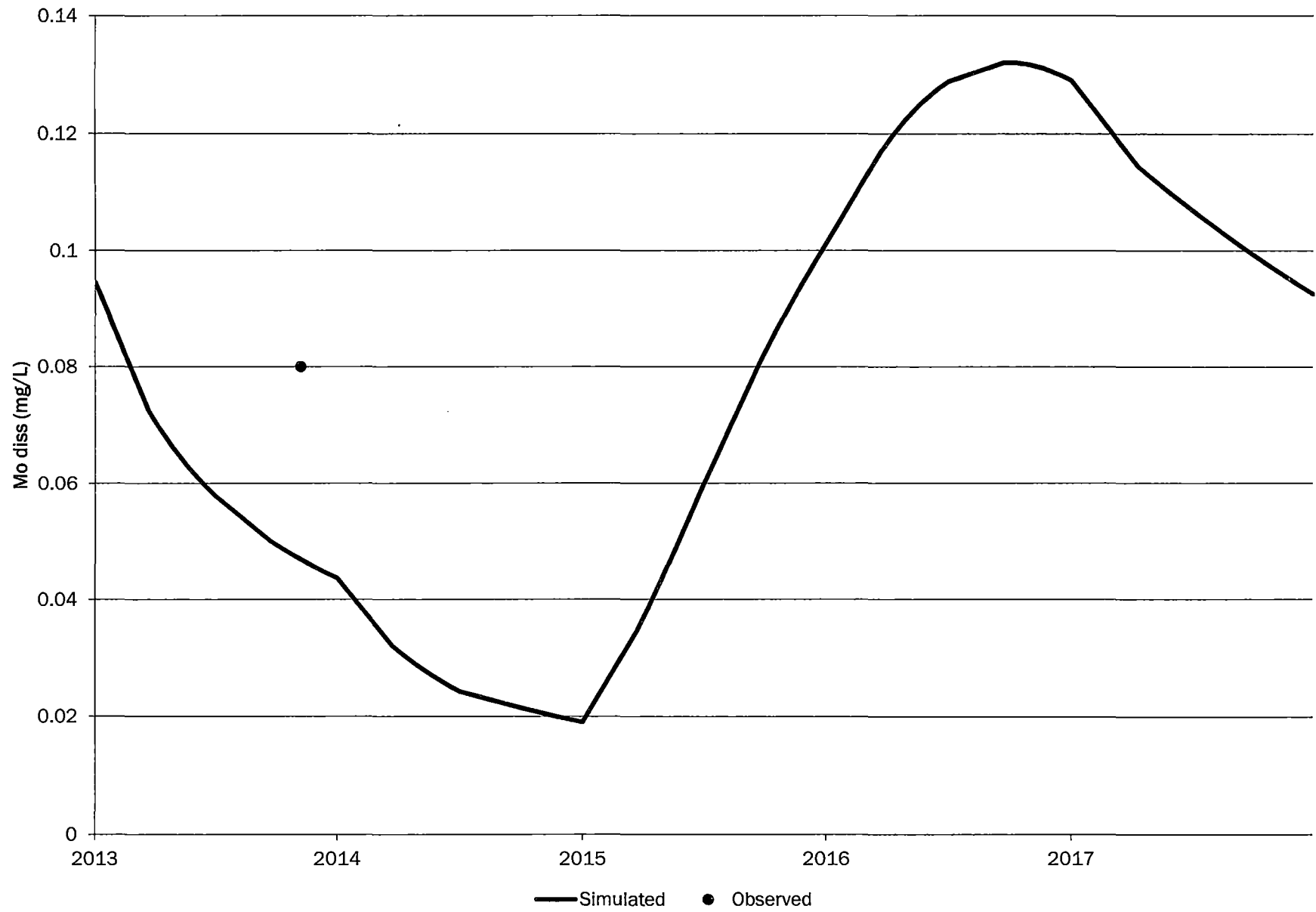
GN-AI



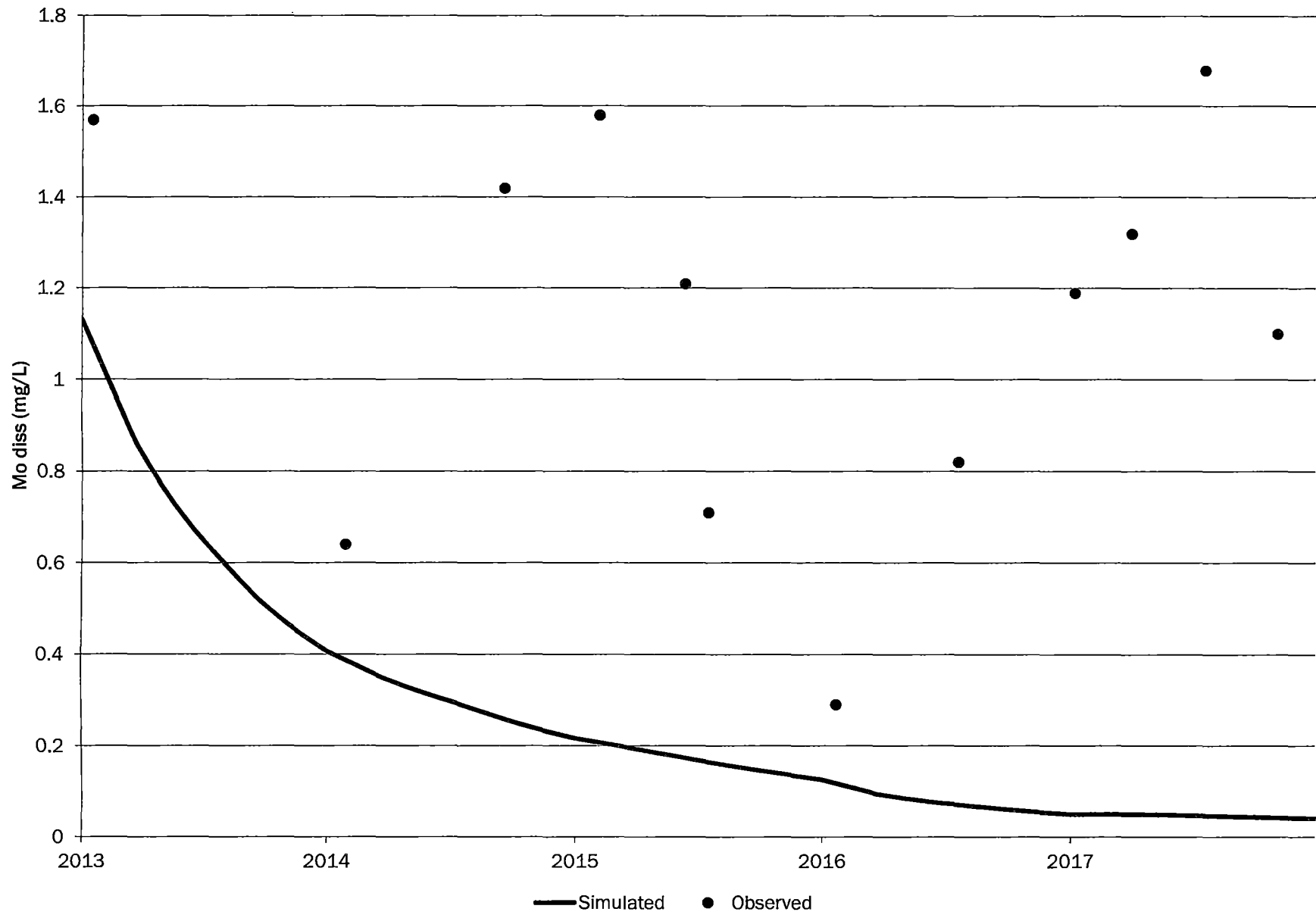
GV-AI



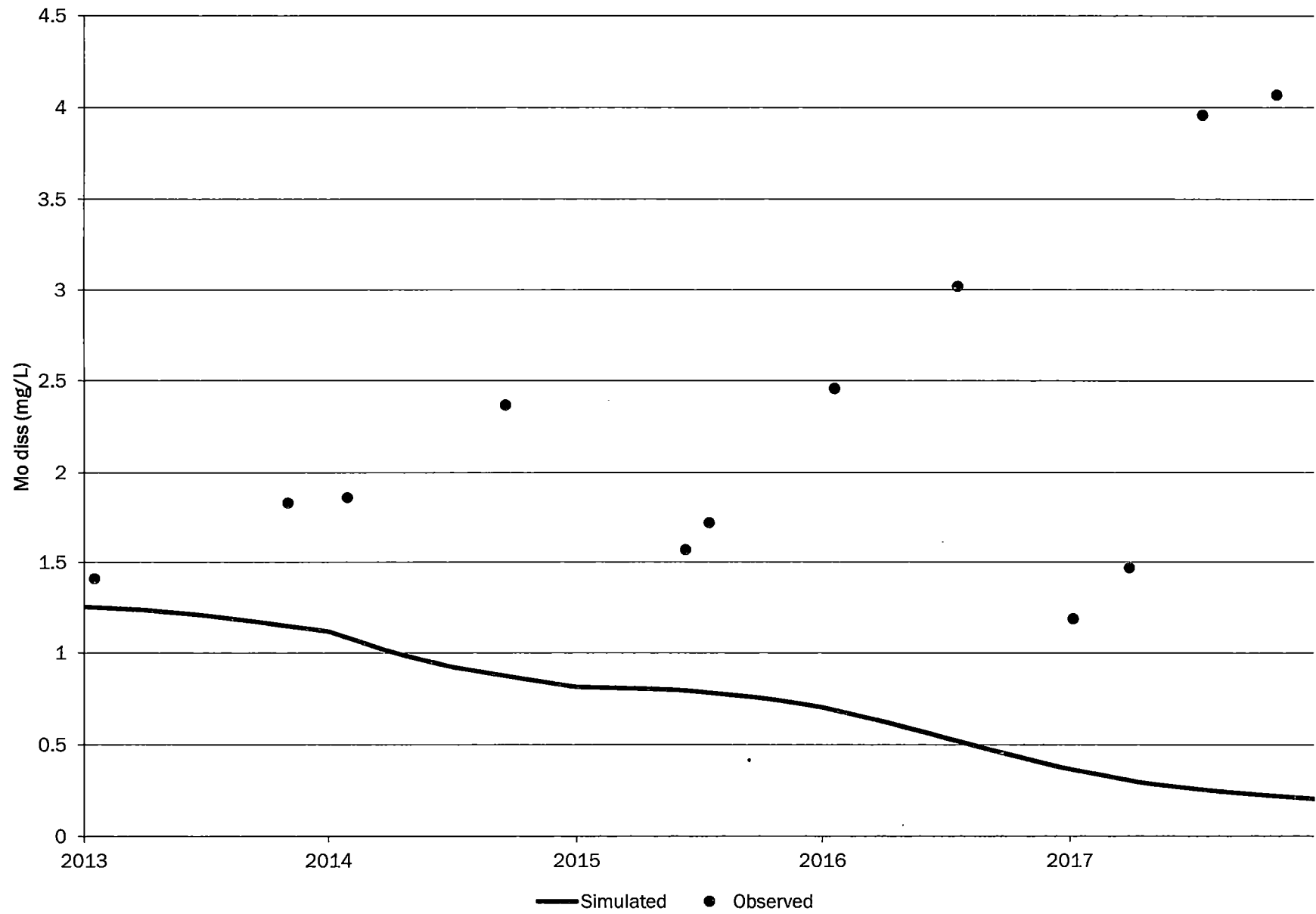
K2-AI



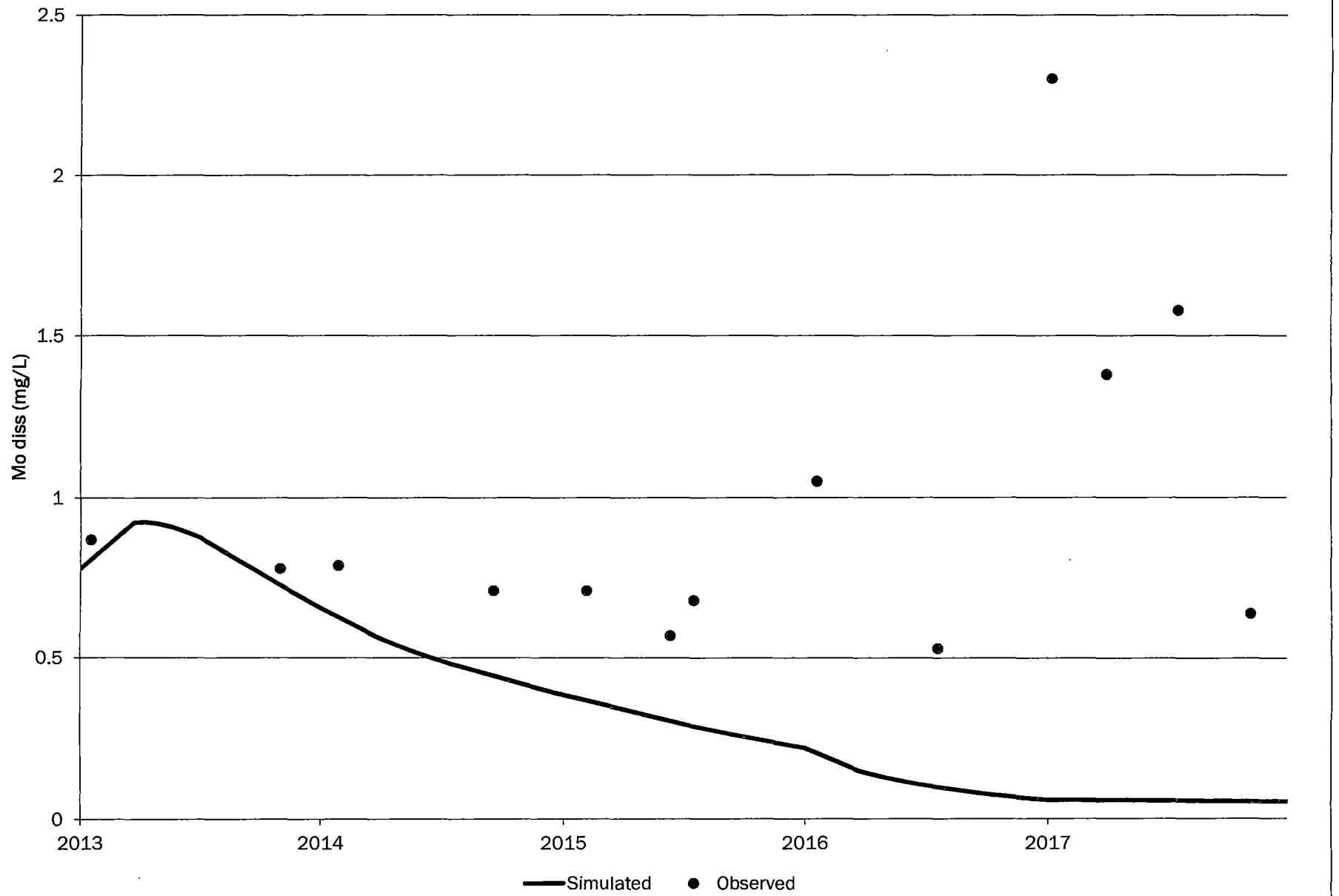
K4-AI



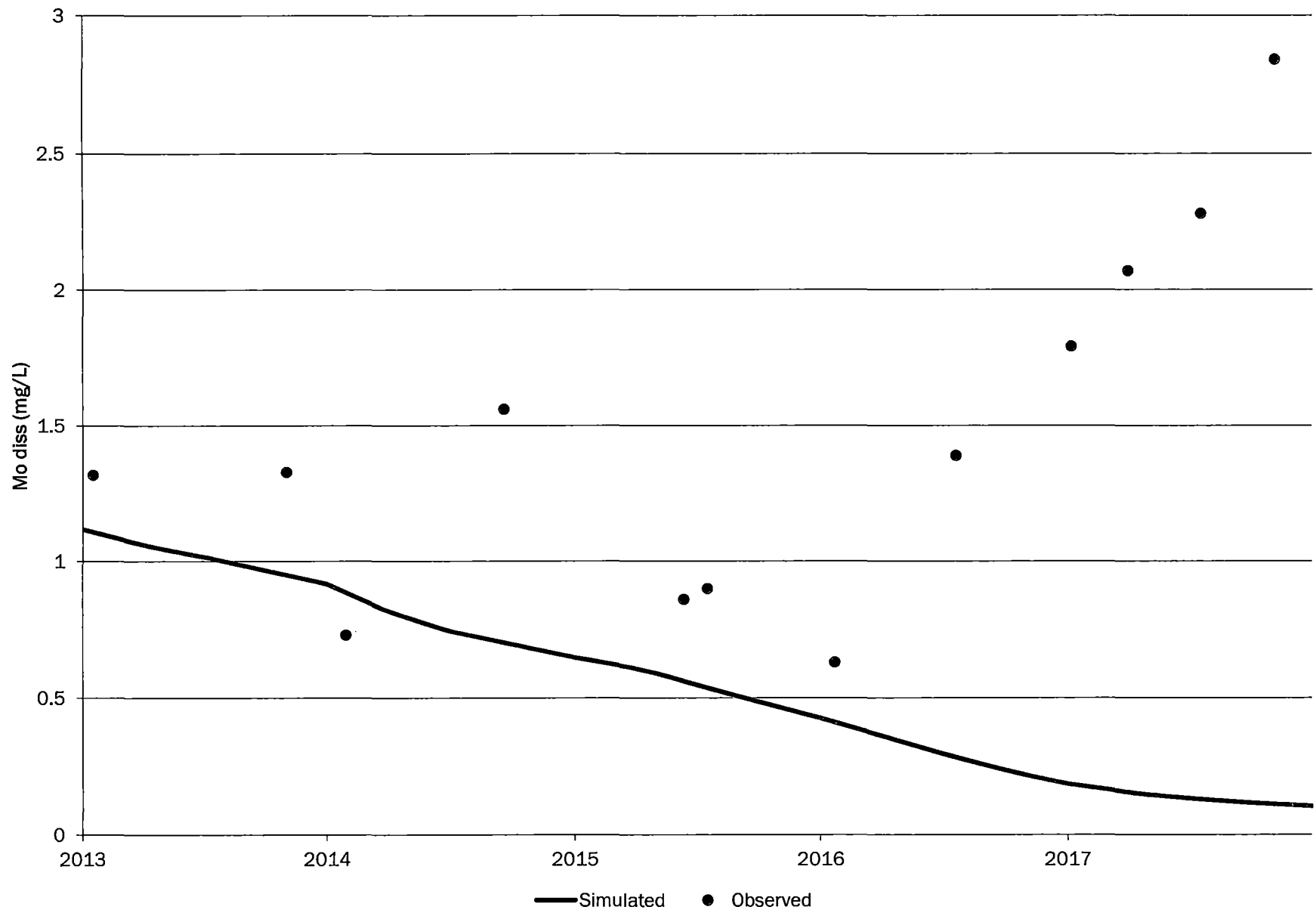
K5-AI



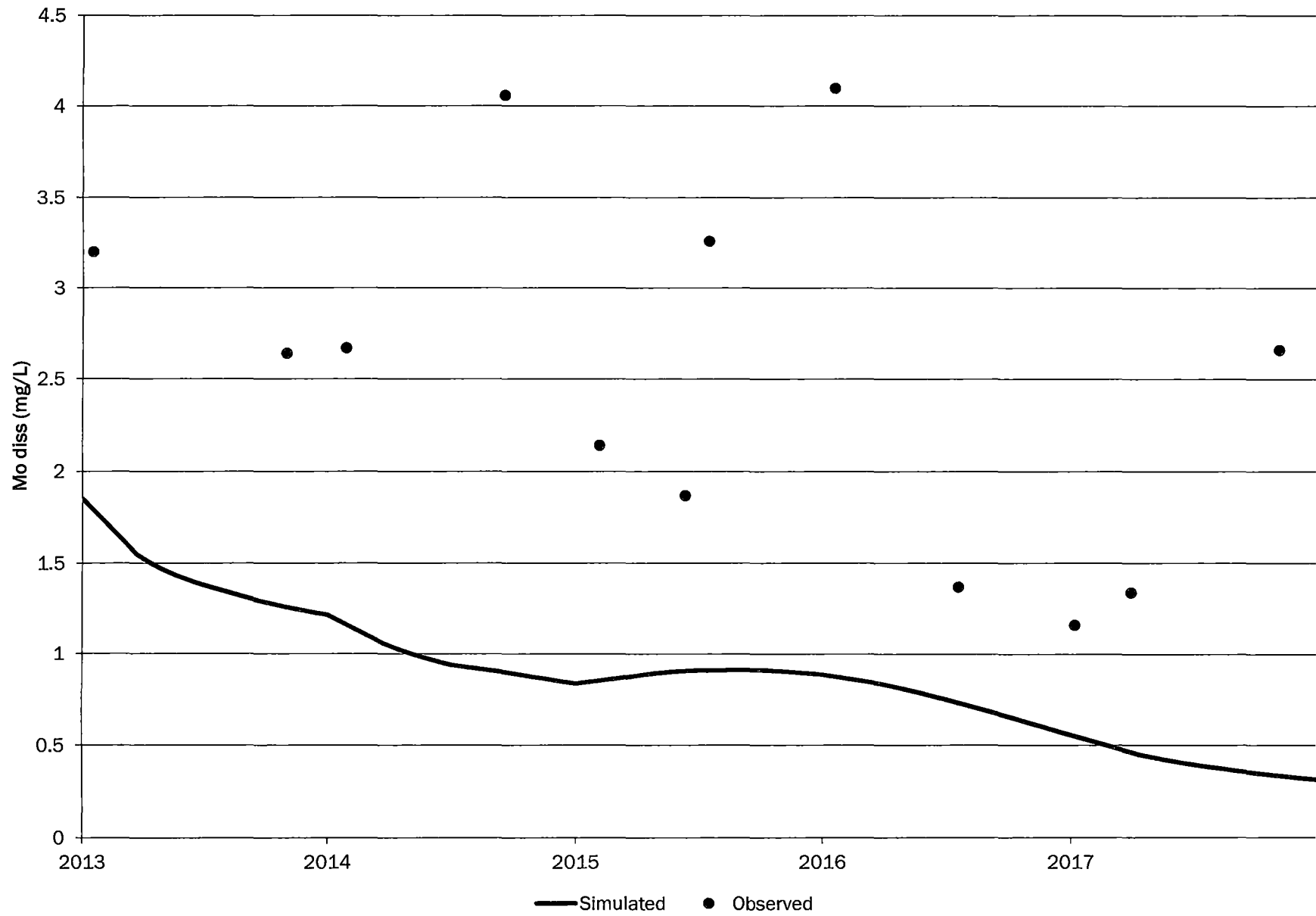
K7-AI



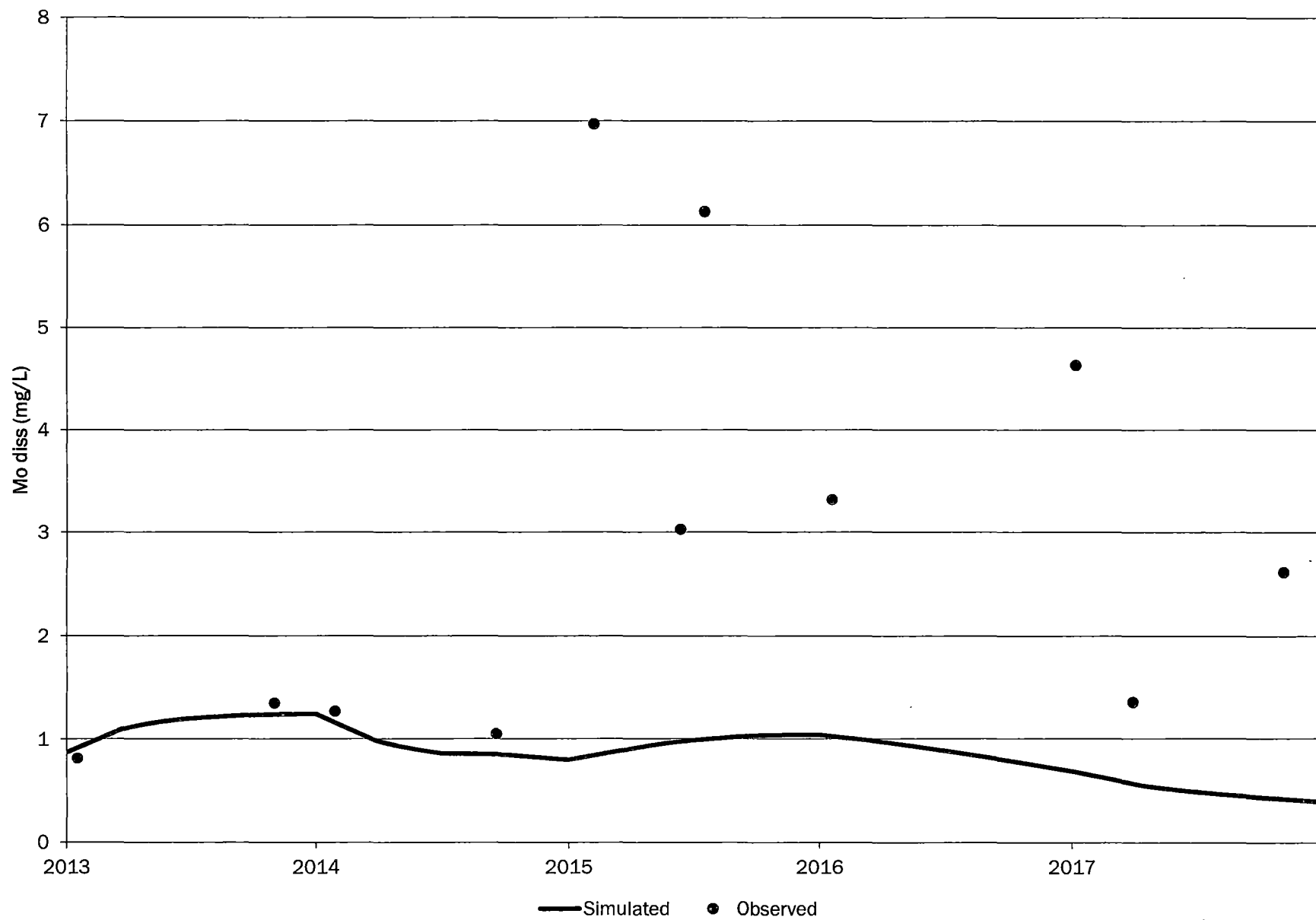
K8-AI



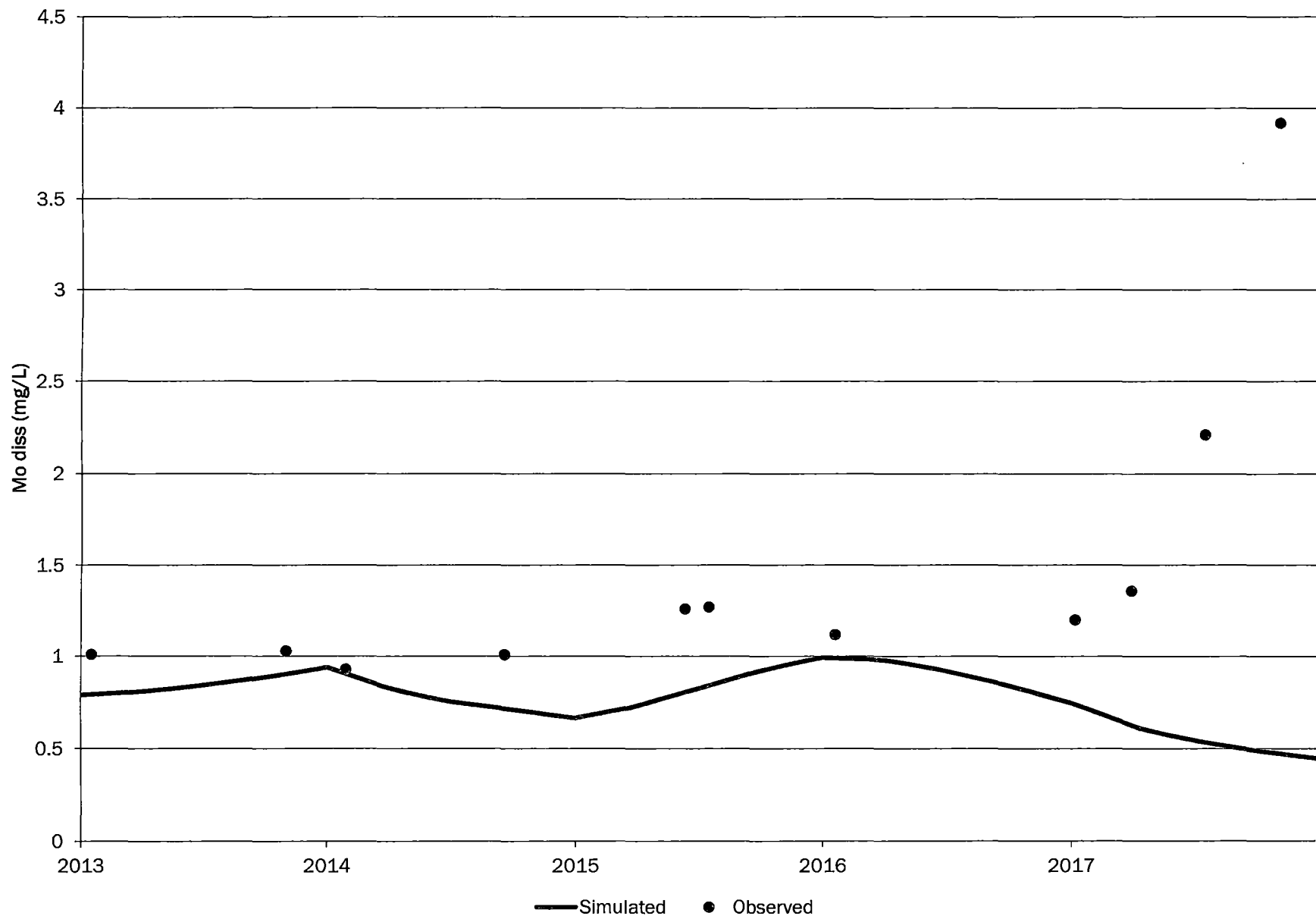
K9-AI



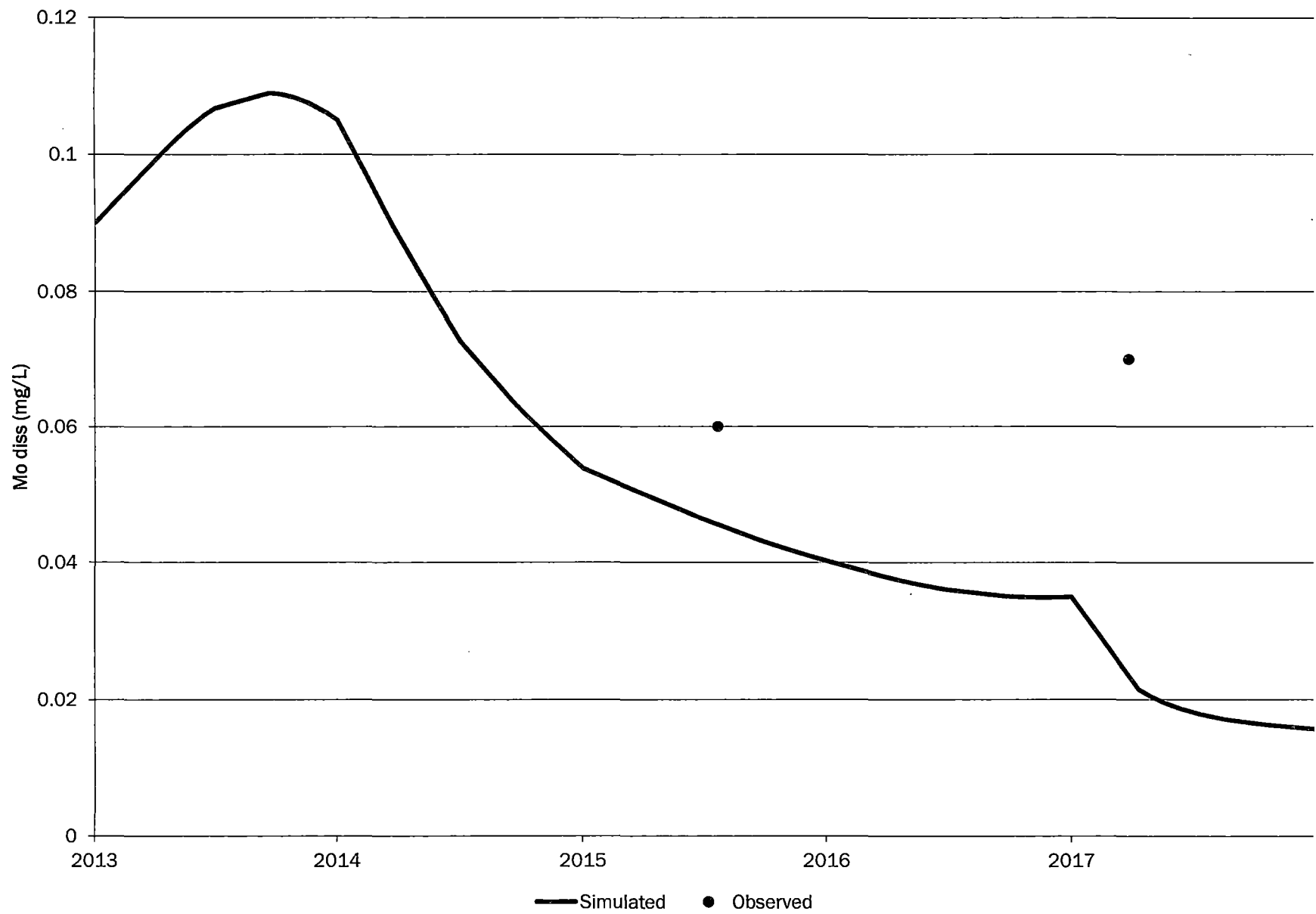
K10-AI



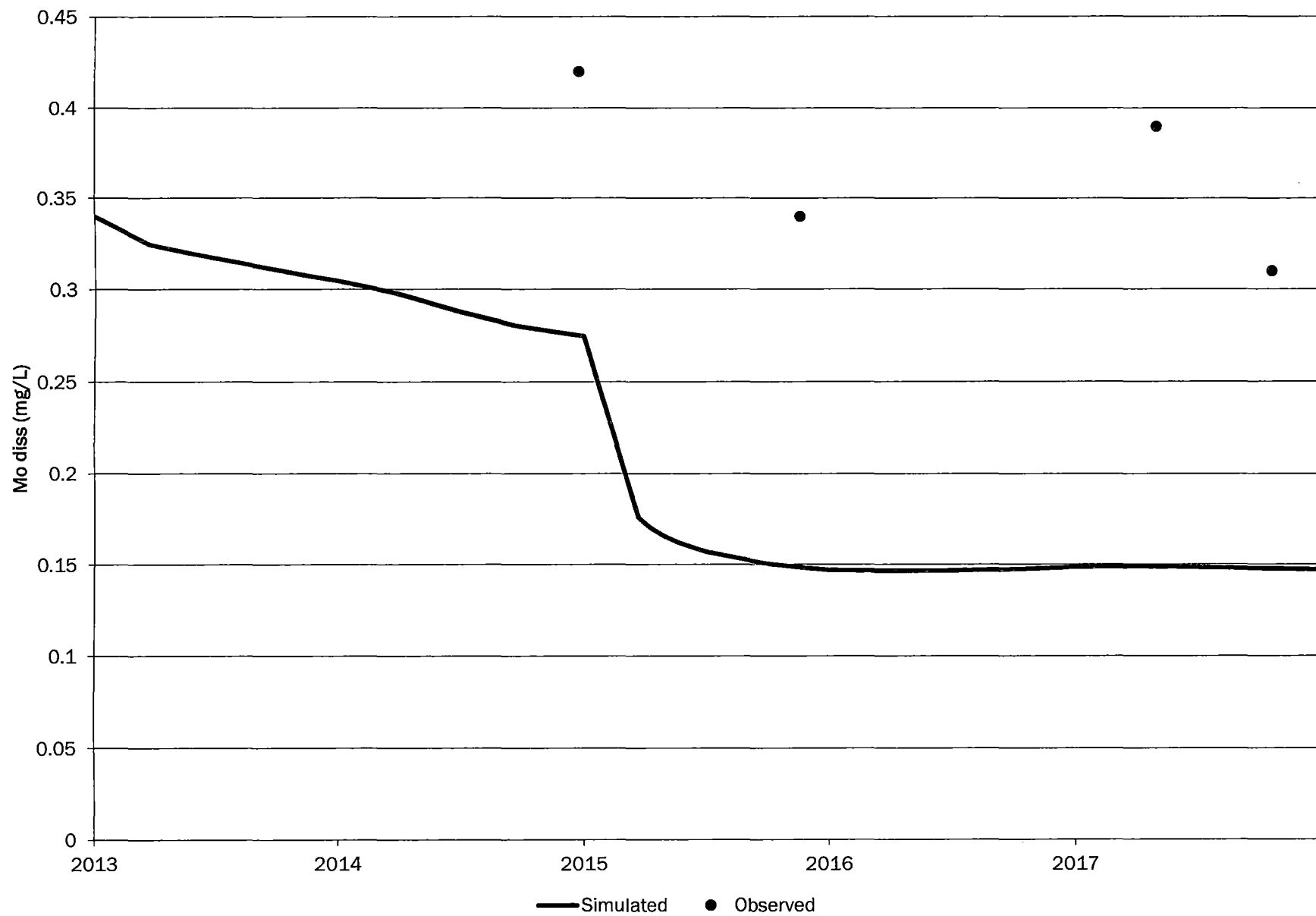
K11-AI



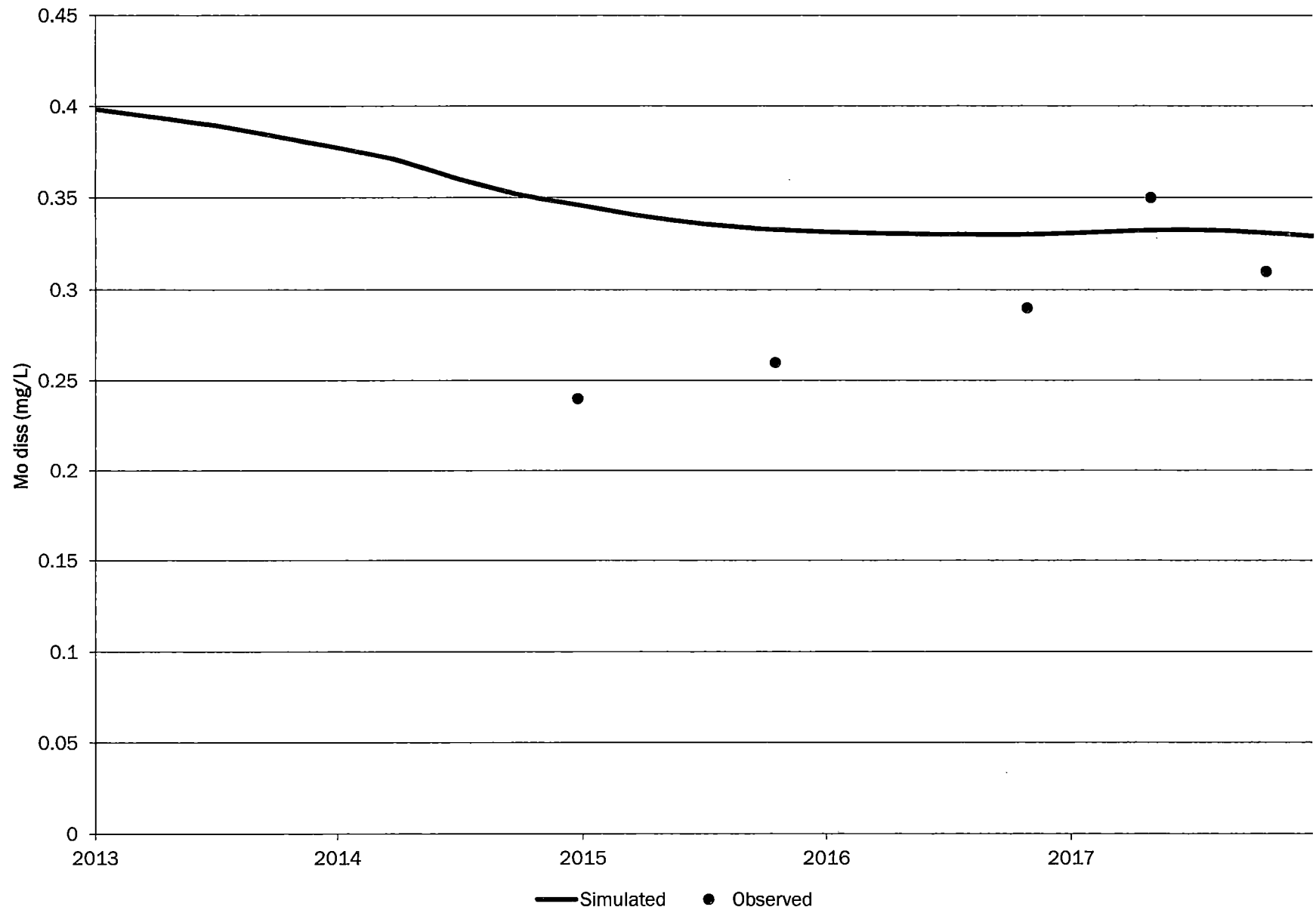
KF-AI



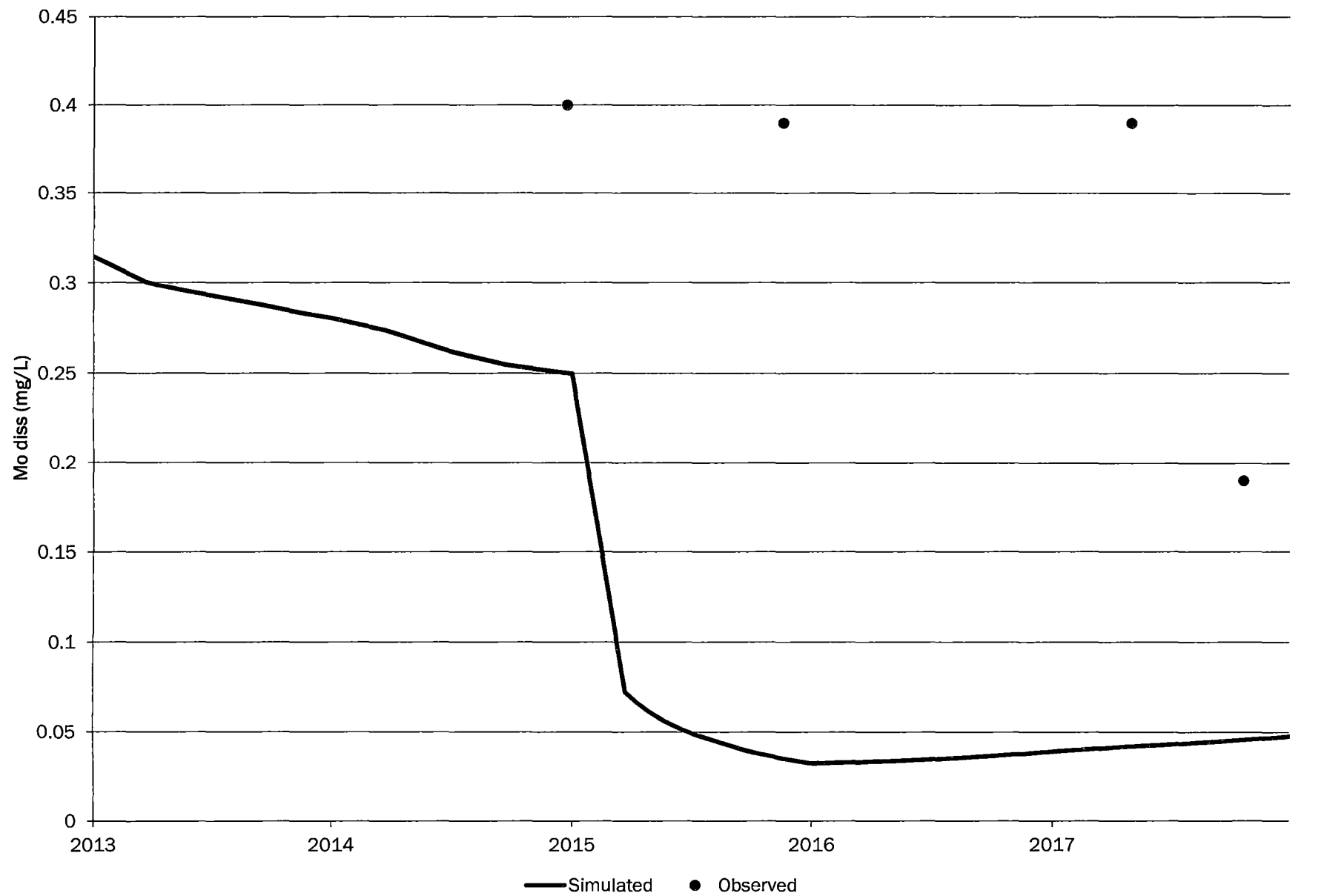
L5-AI



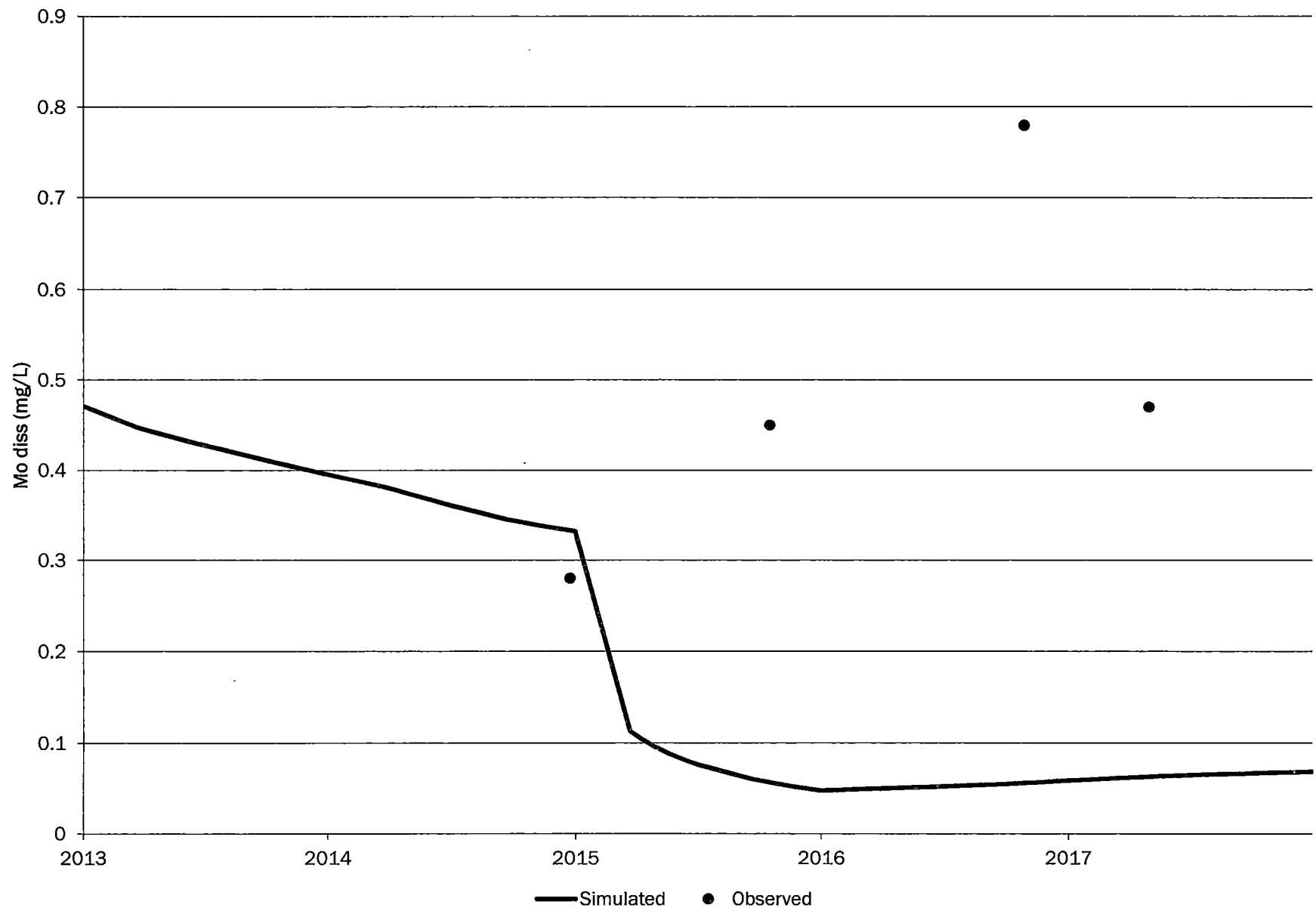
L6-AI



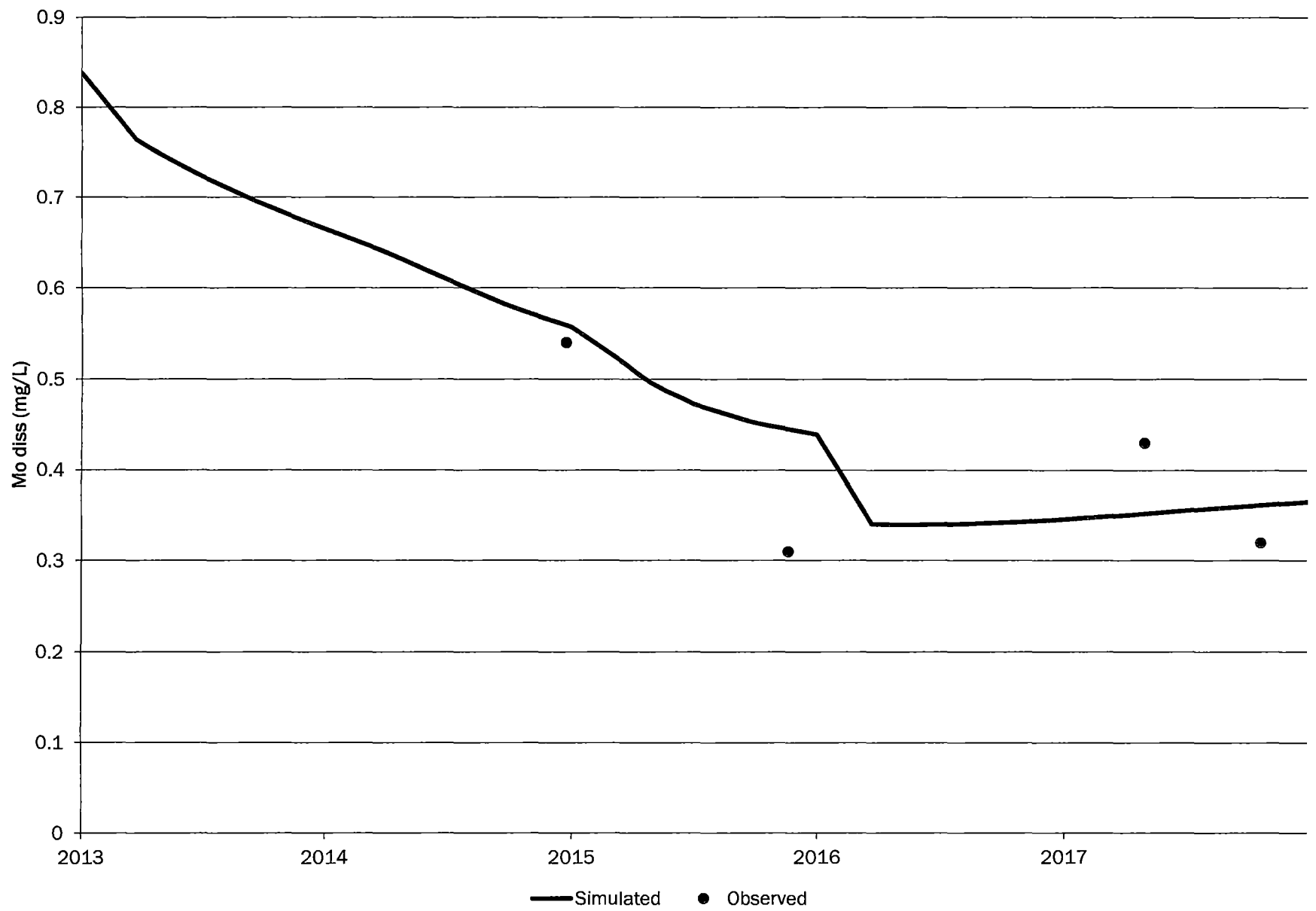
L7-AI



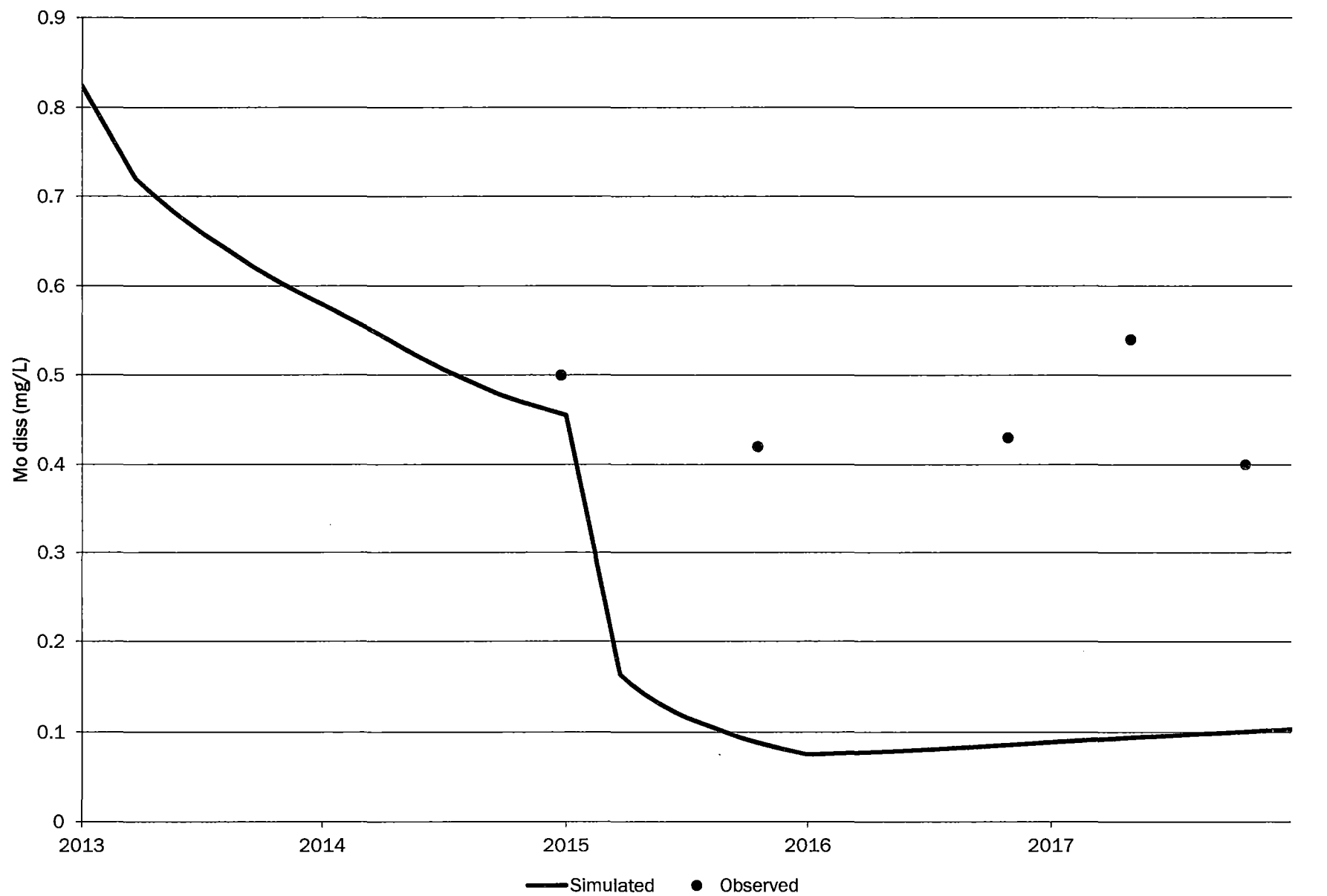
L8-AI



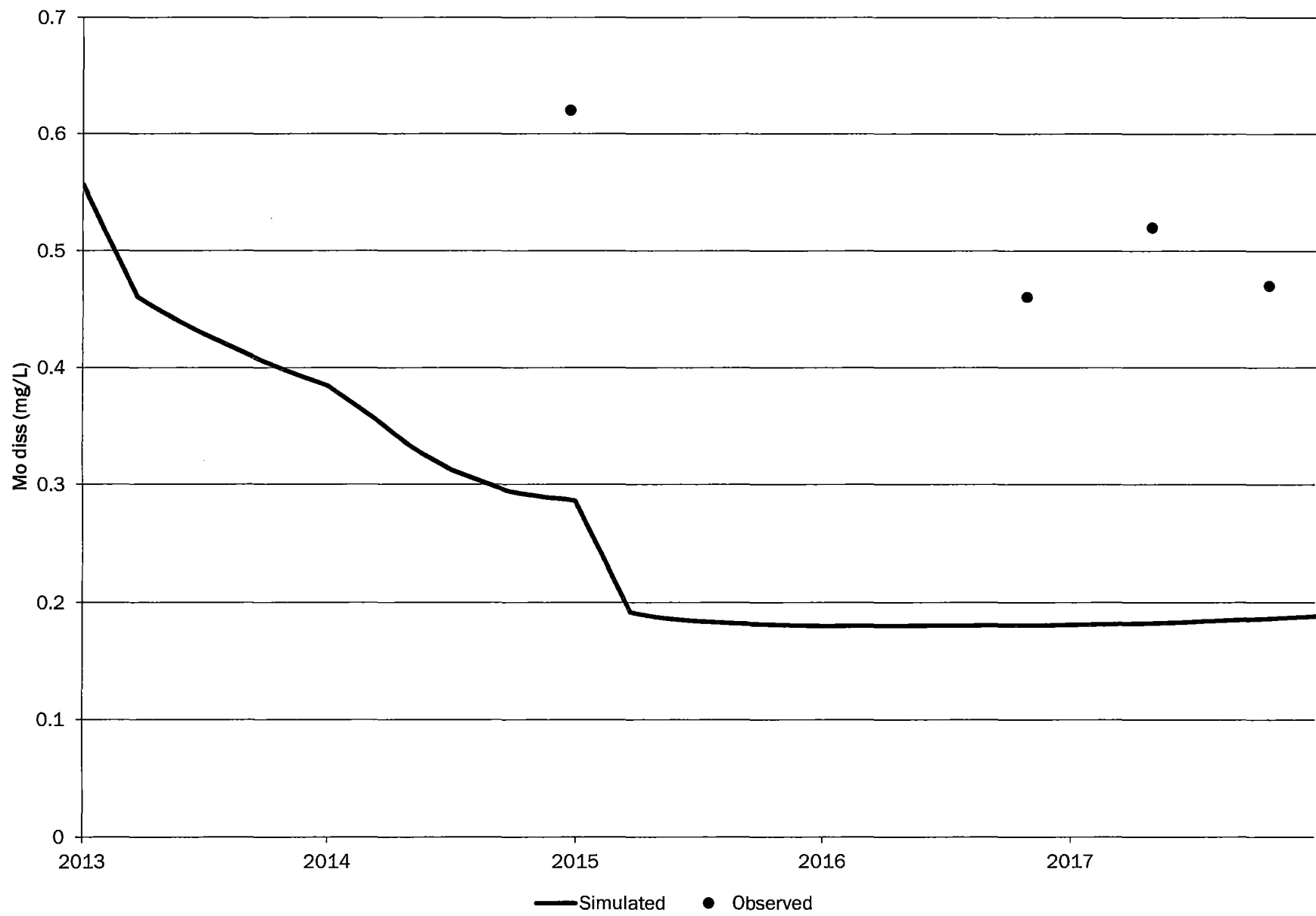
L9-AI



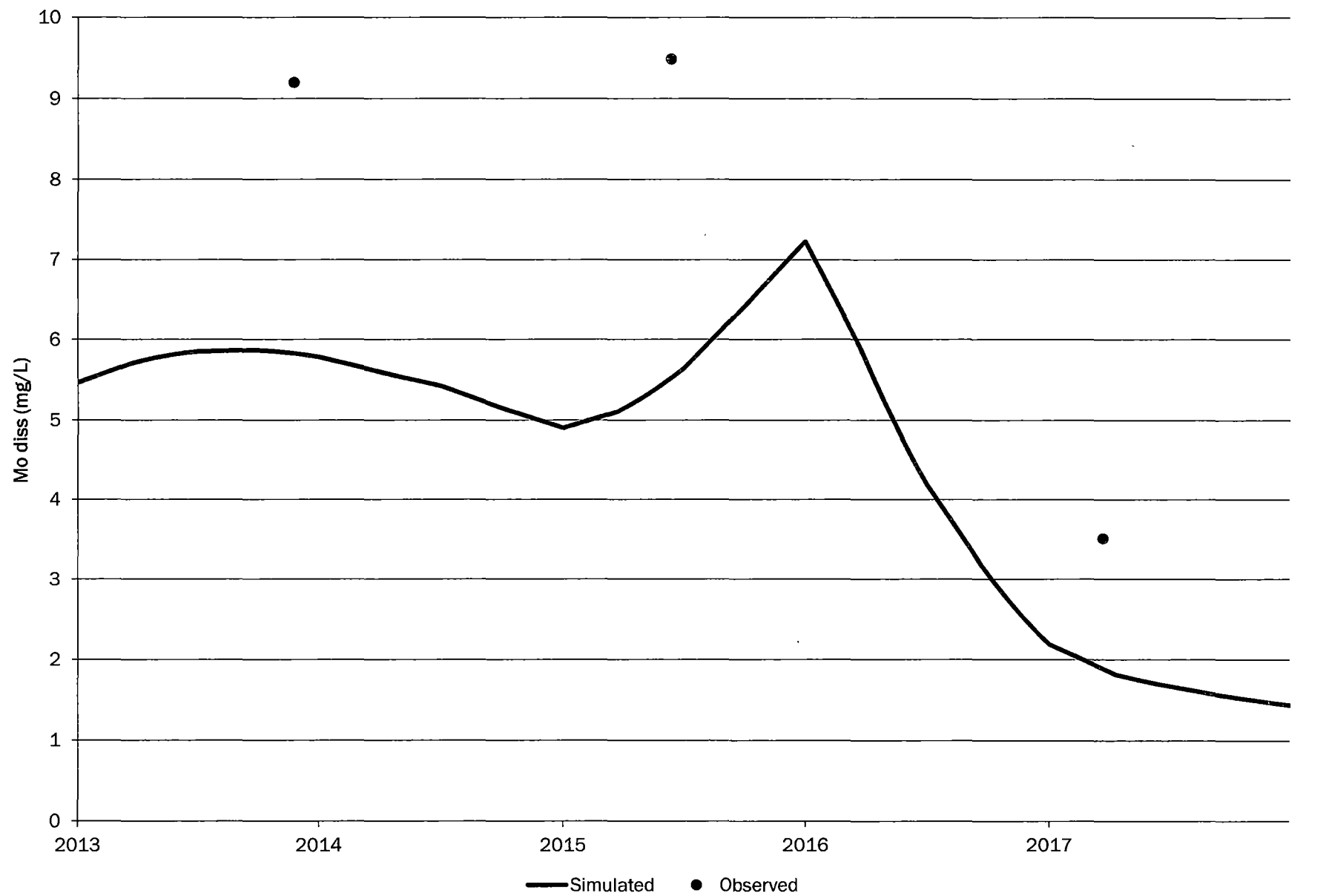
L10-AI



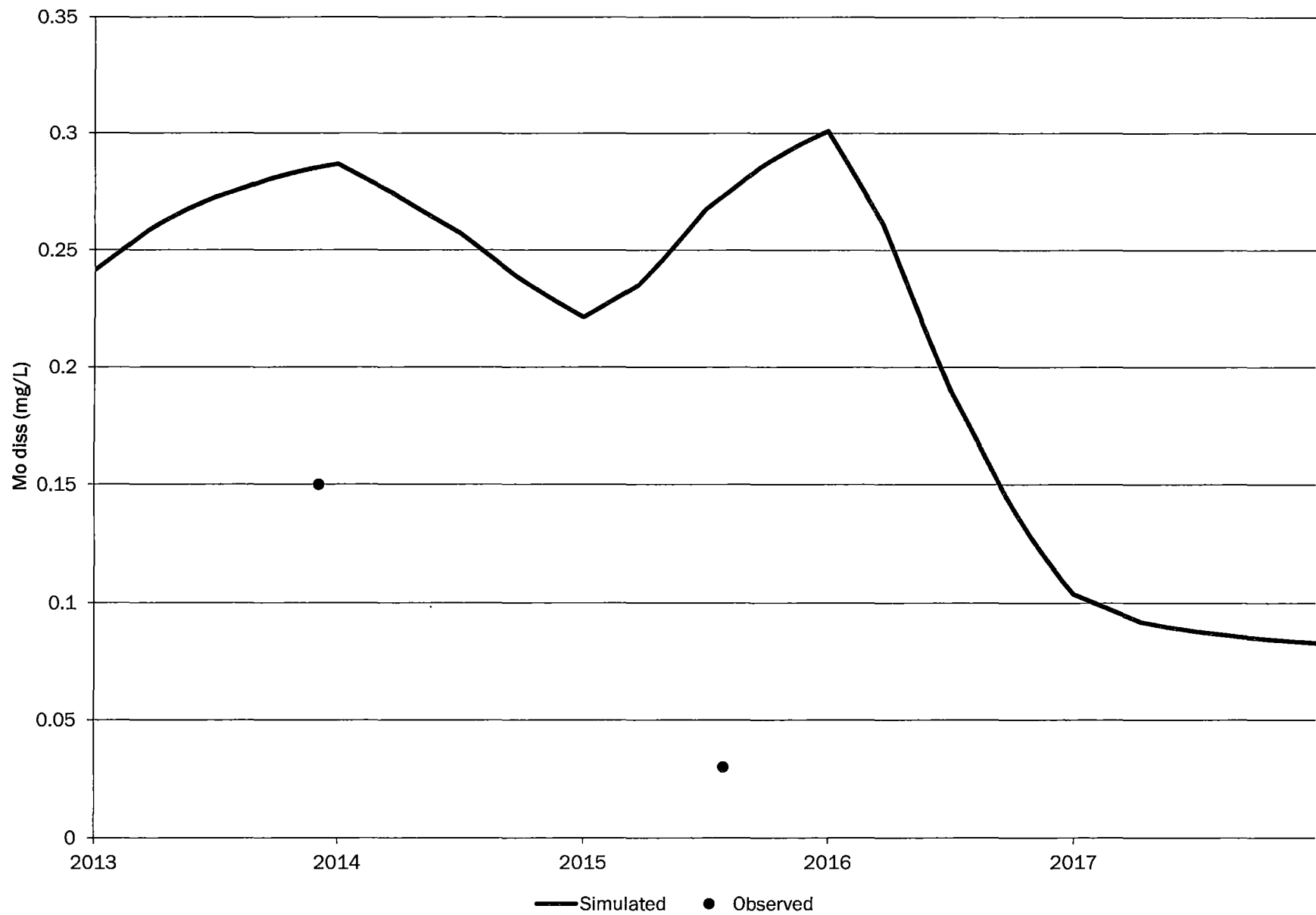
L-AI



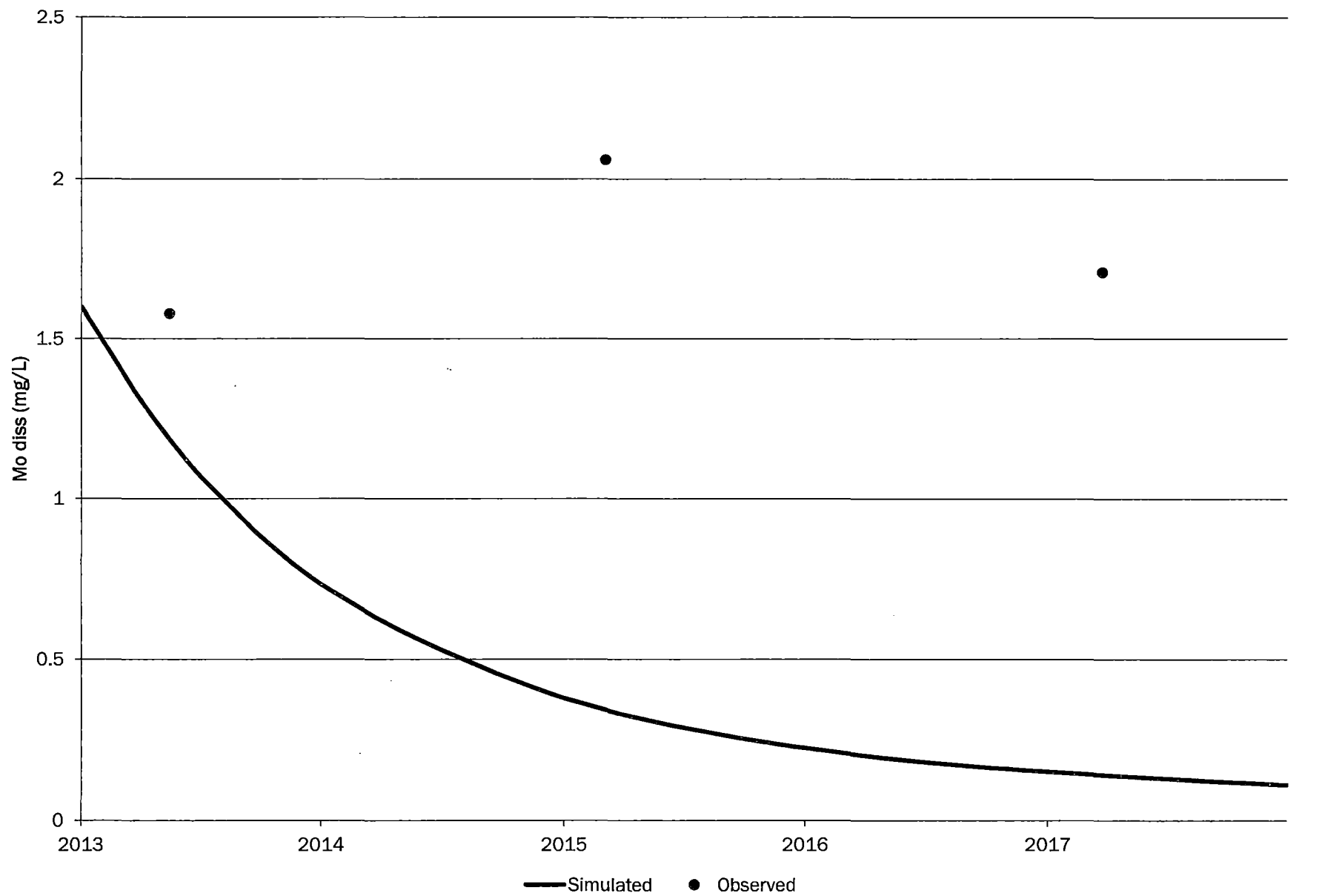
M3-AI



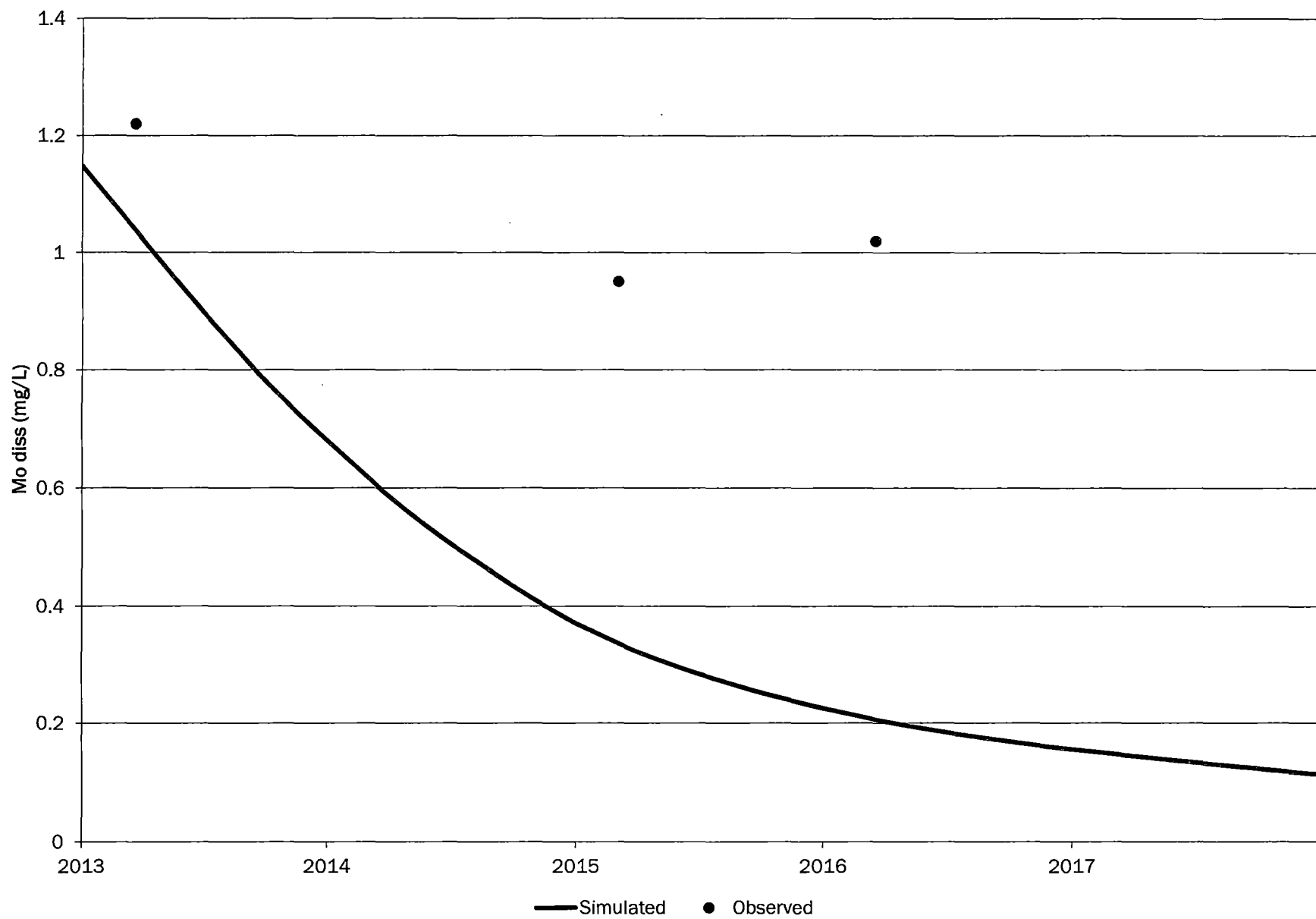
M5-AI



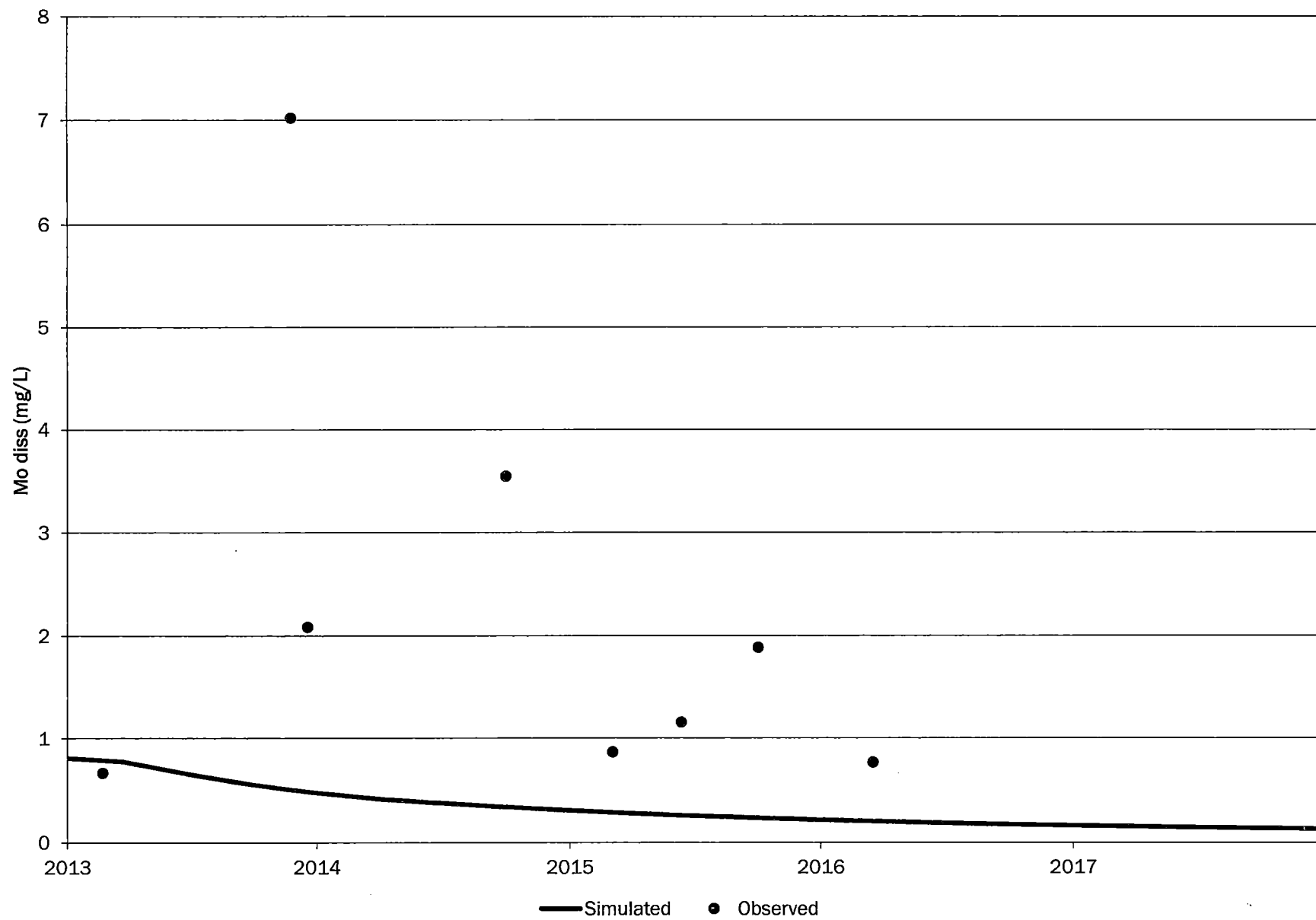
M6-AI



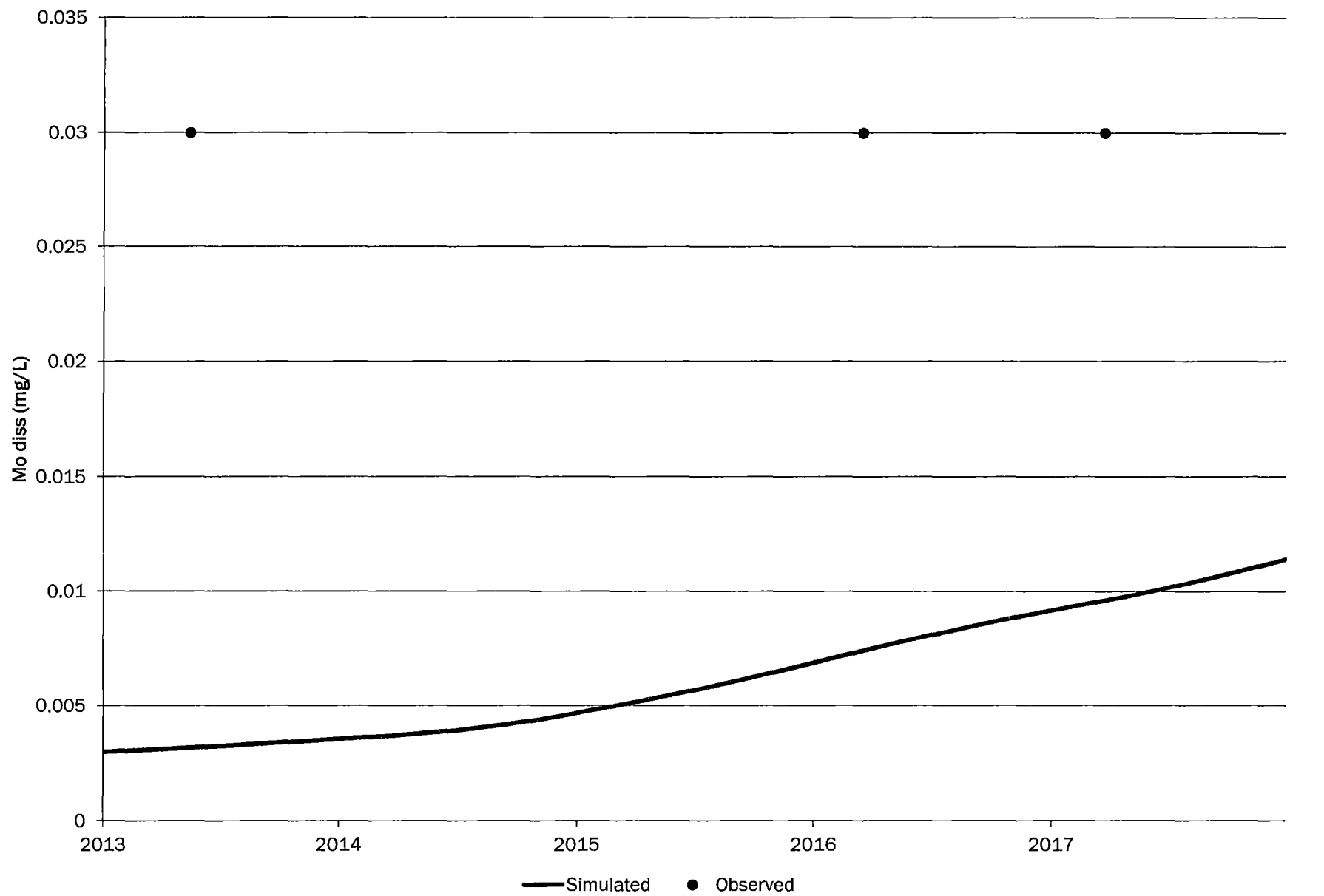
M7-AI



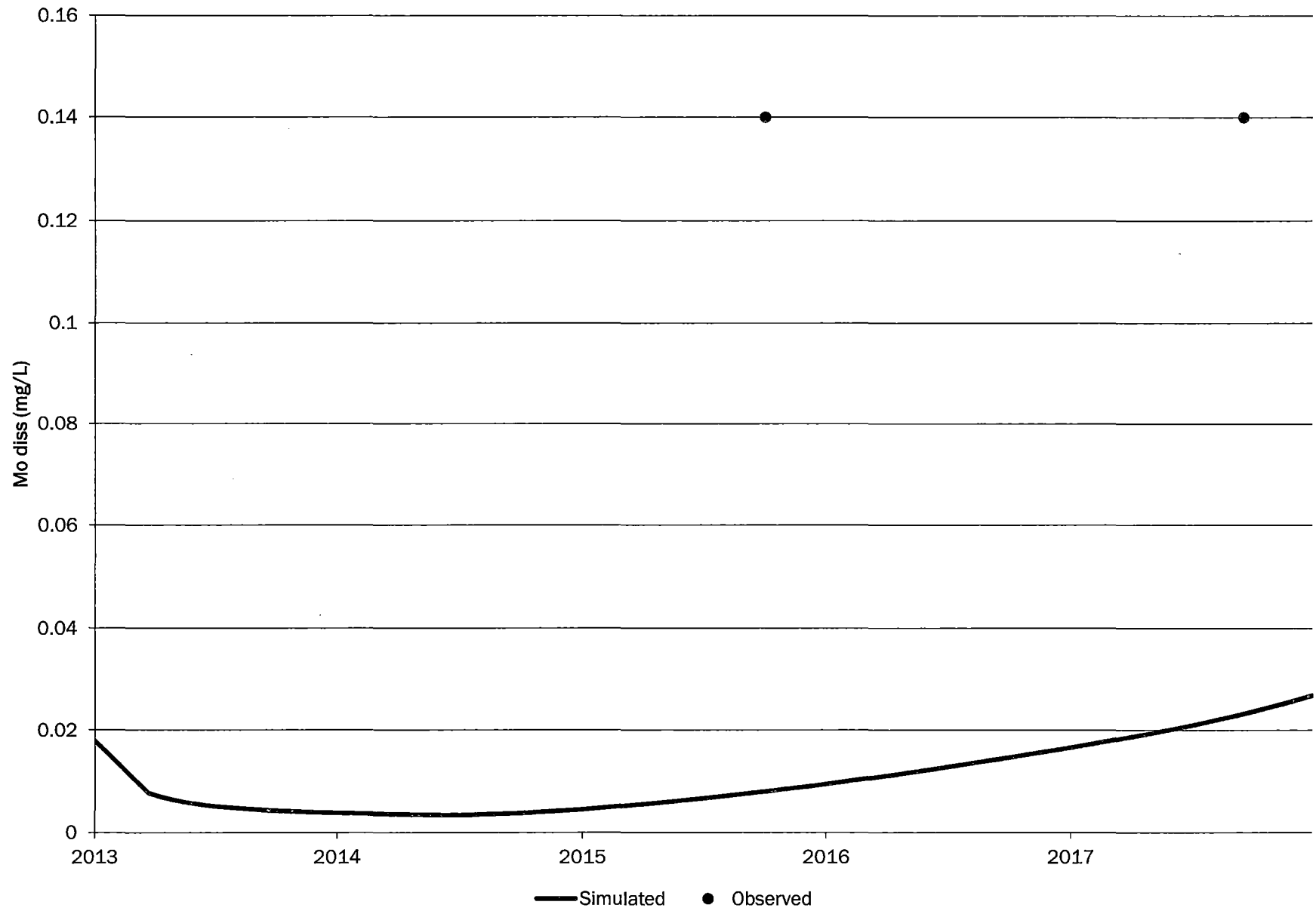
M9-AI



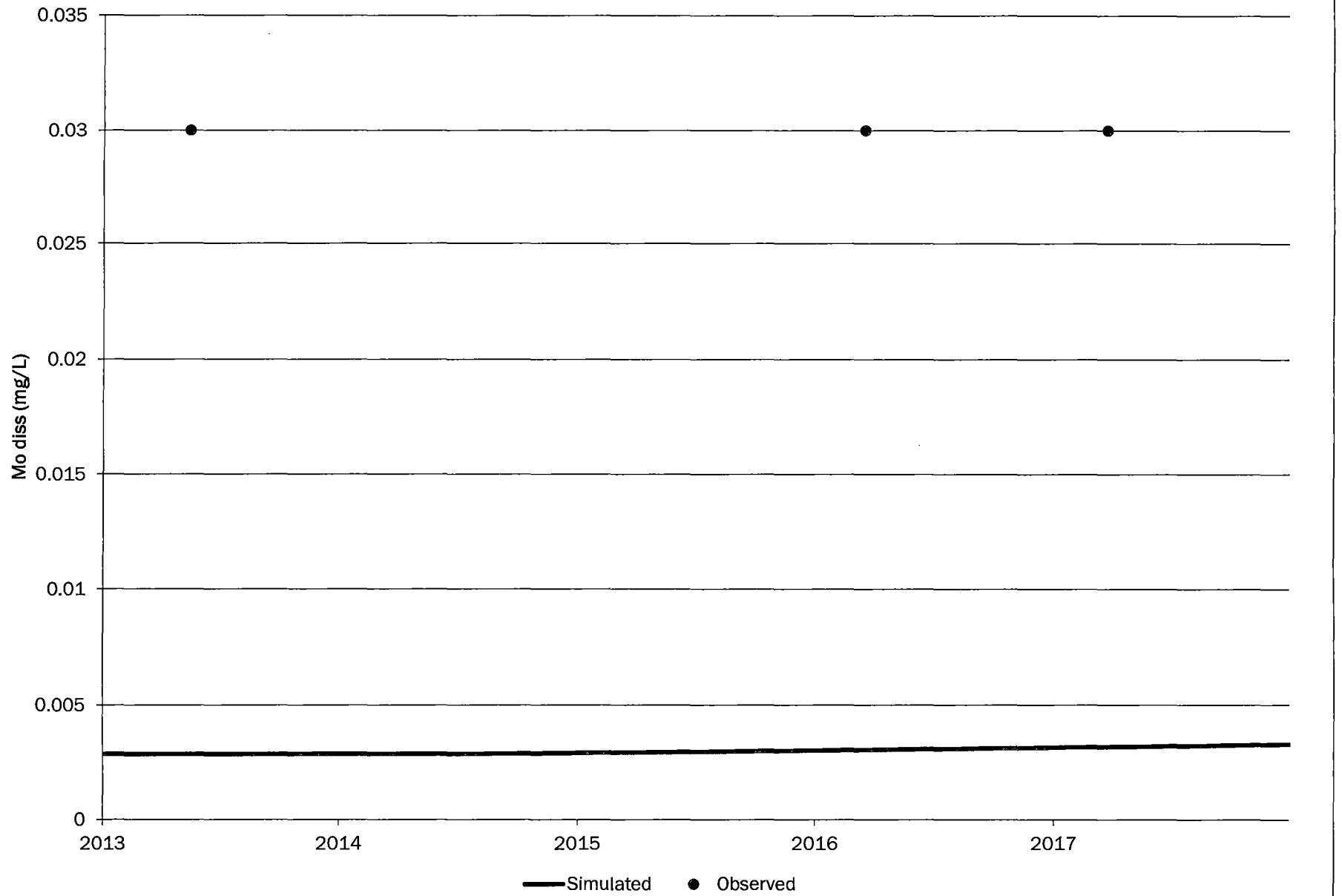
M10-AI



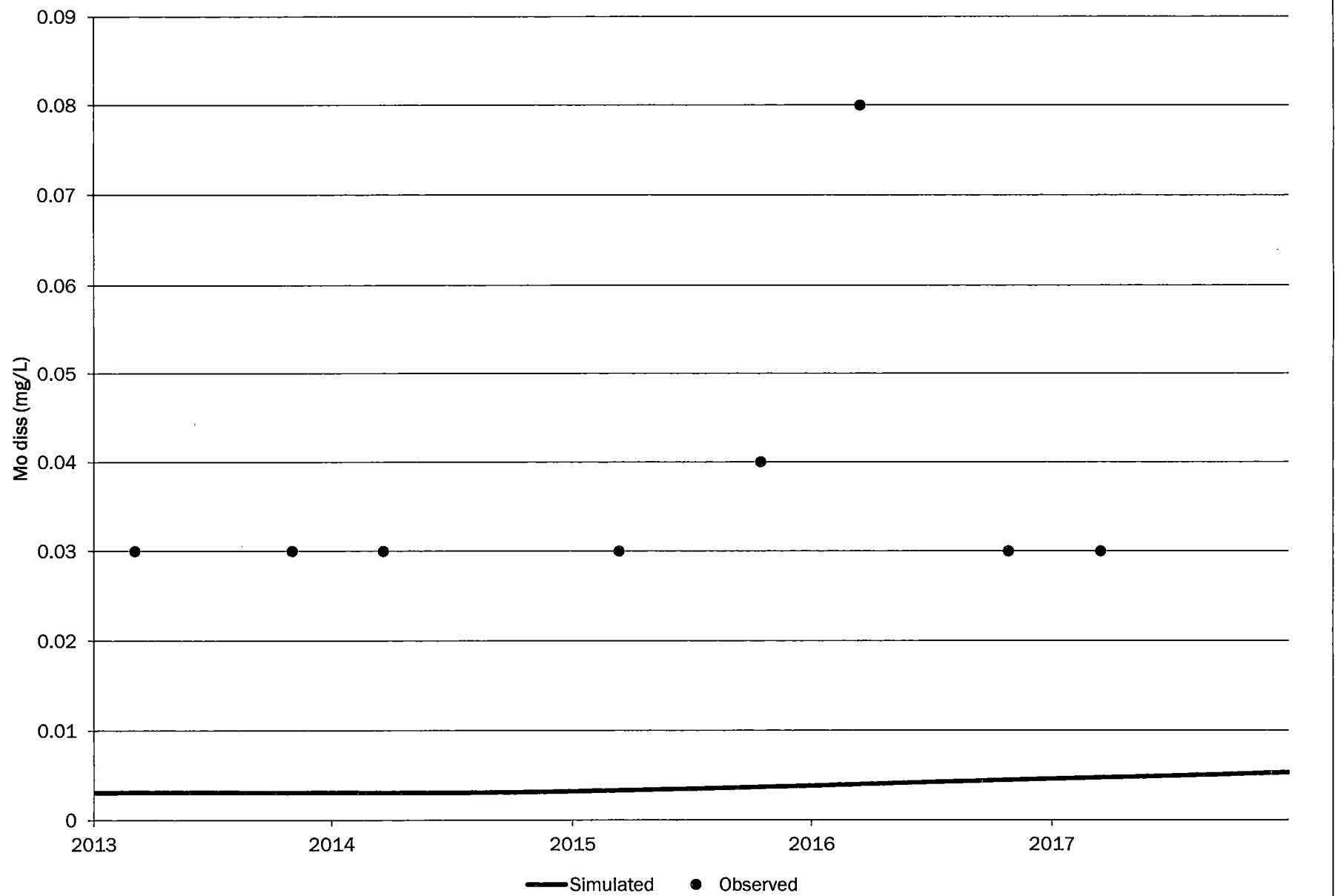
M16-AI



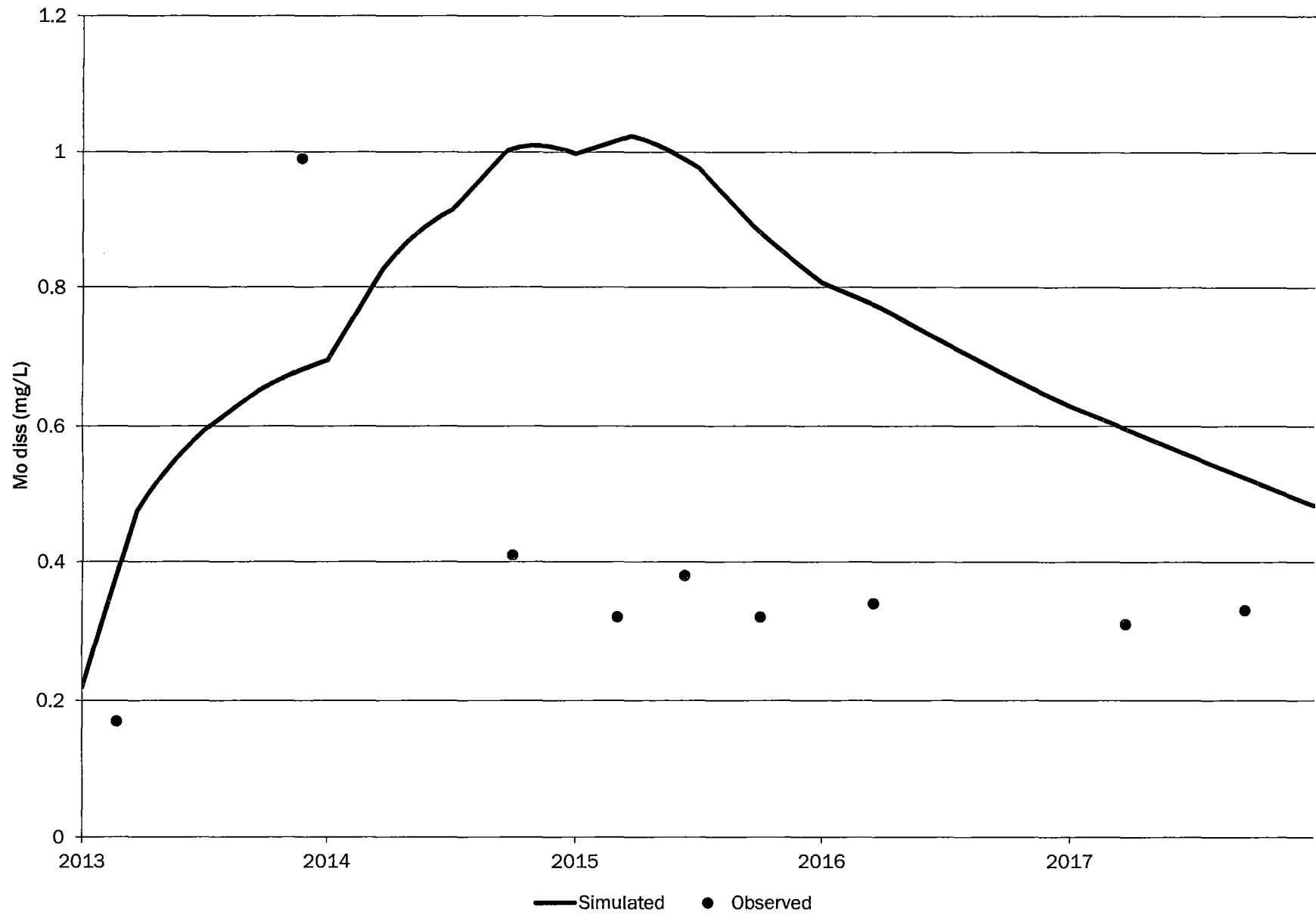
ML-AI



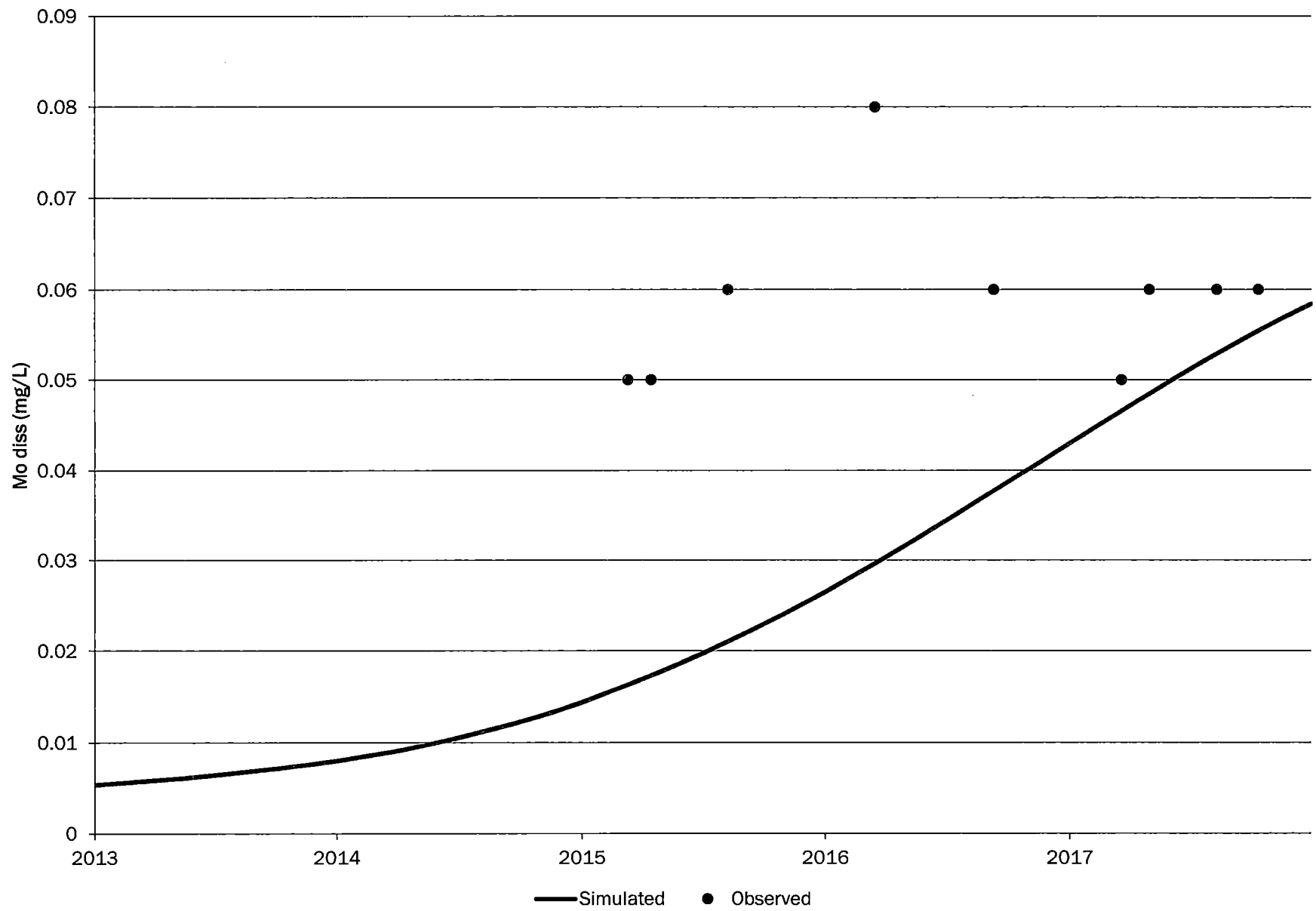
MO-AI



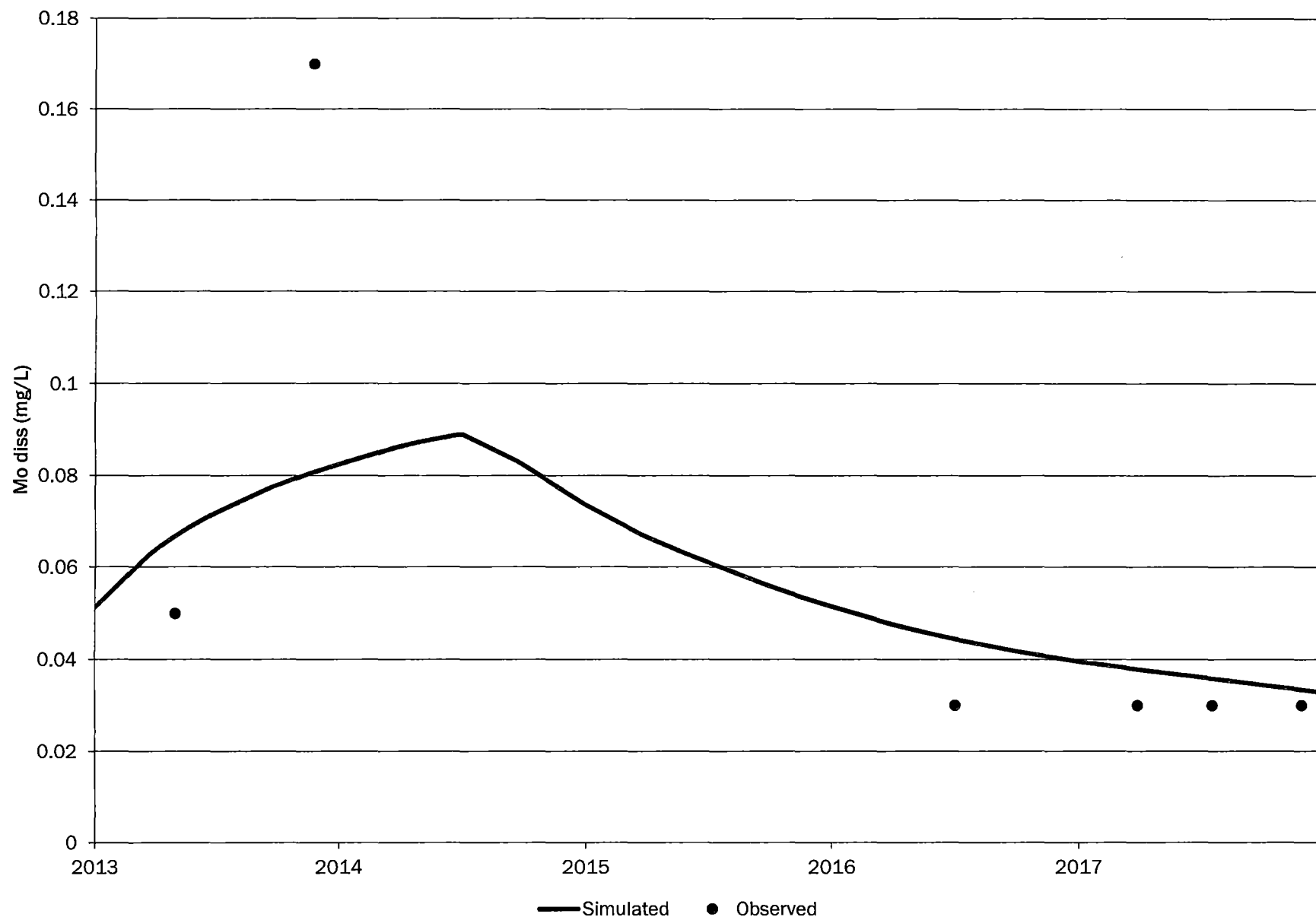
MQ-AI



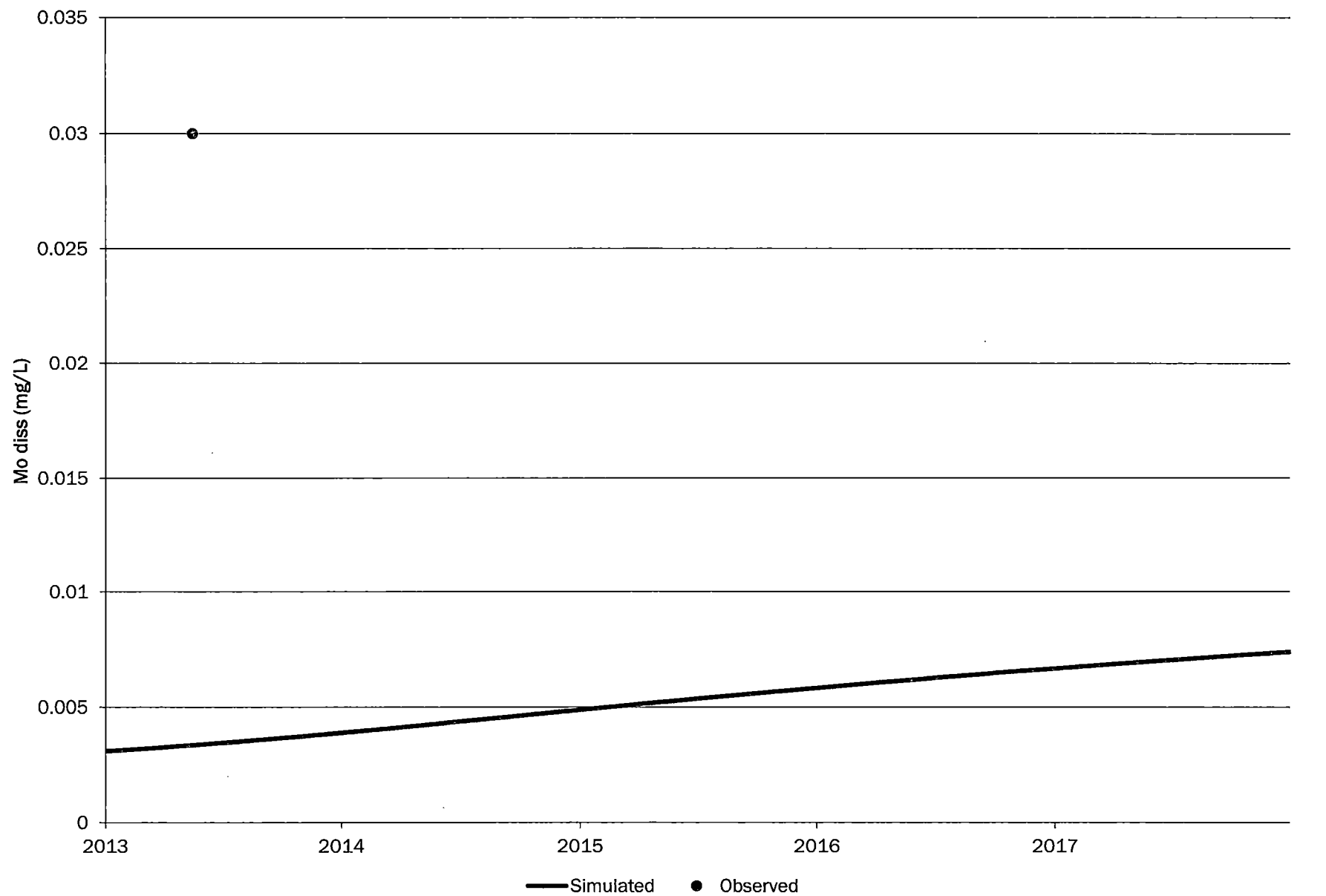
MR-AI



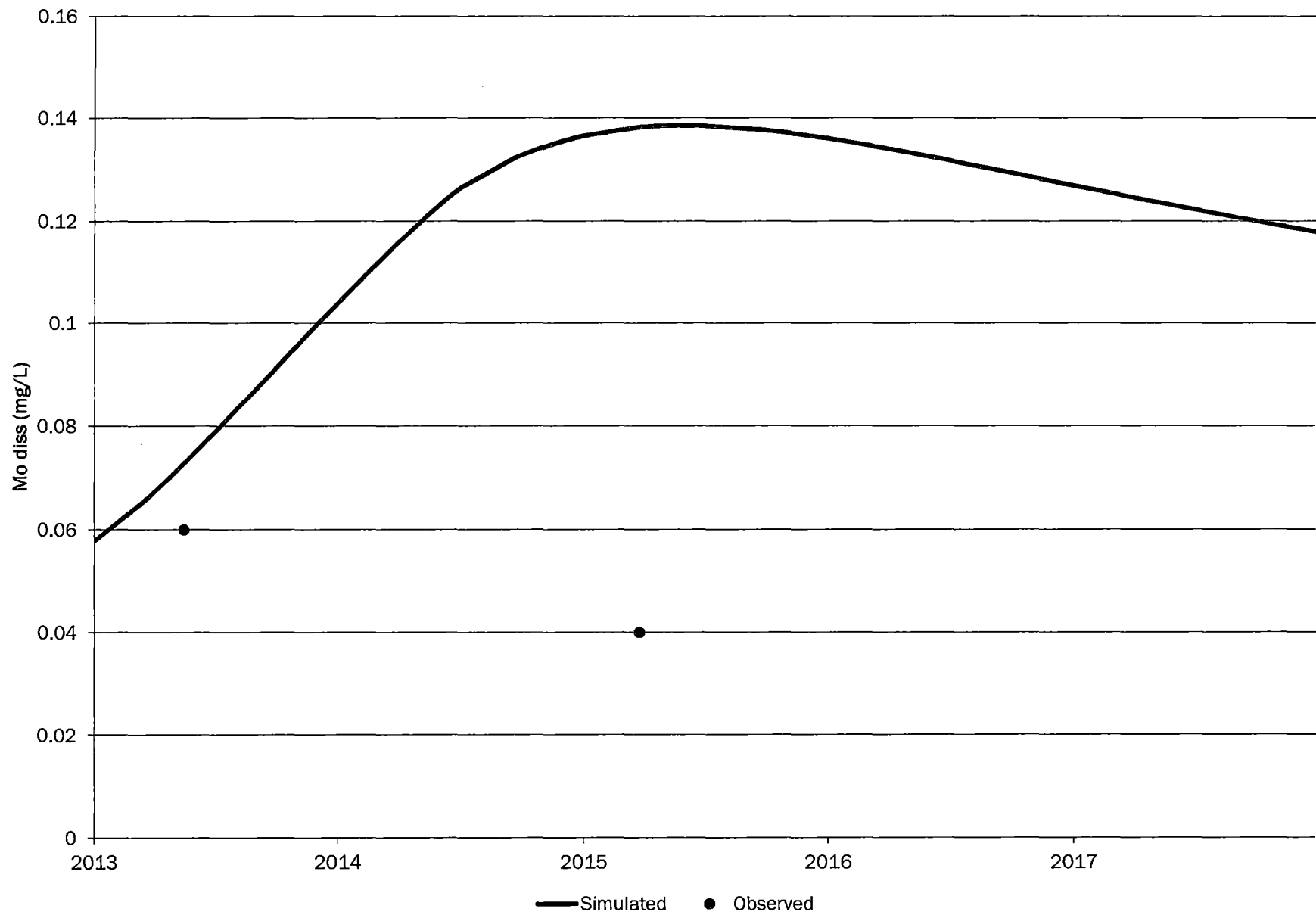
MS-AI



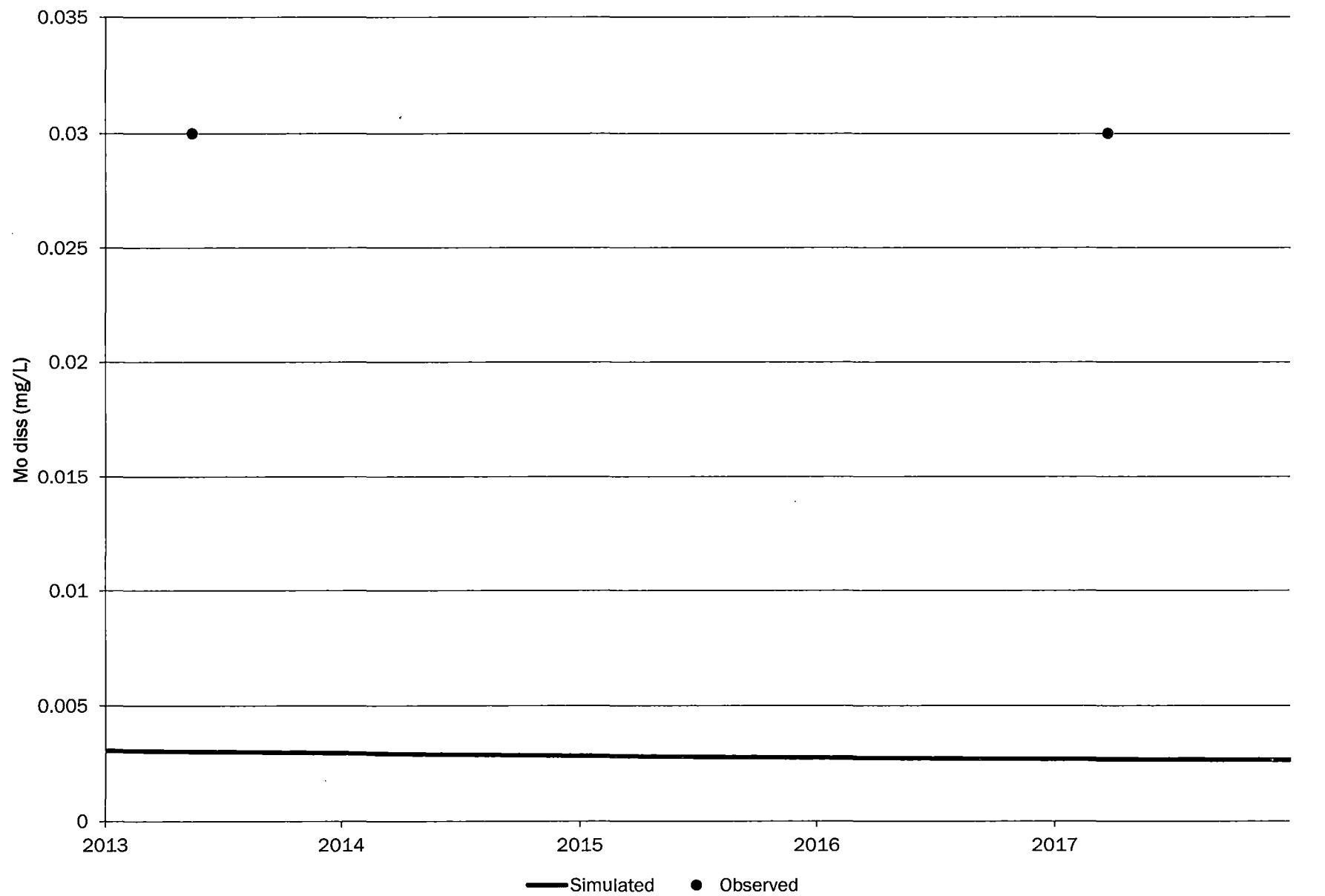
MT-AI



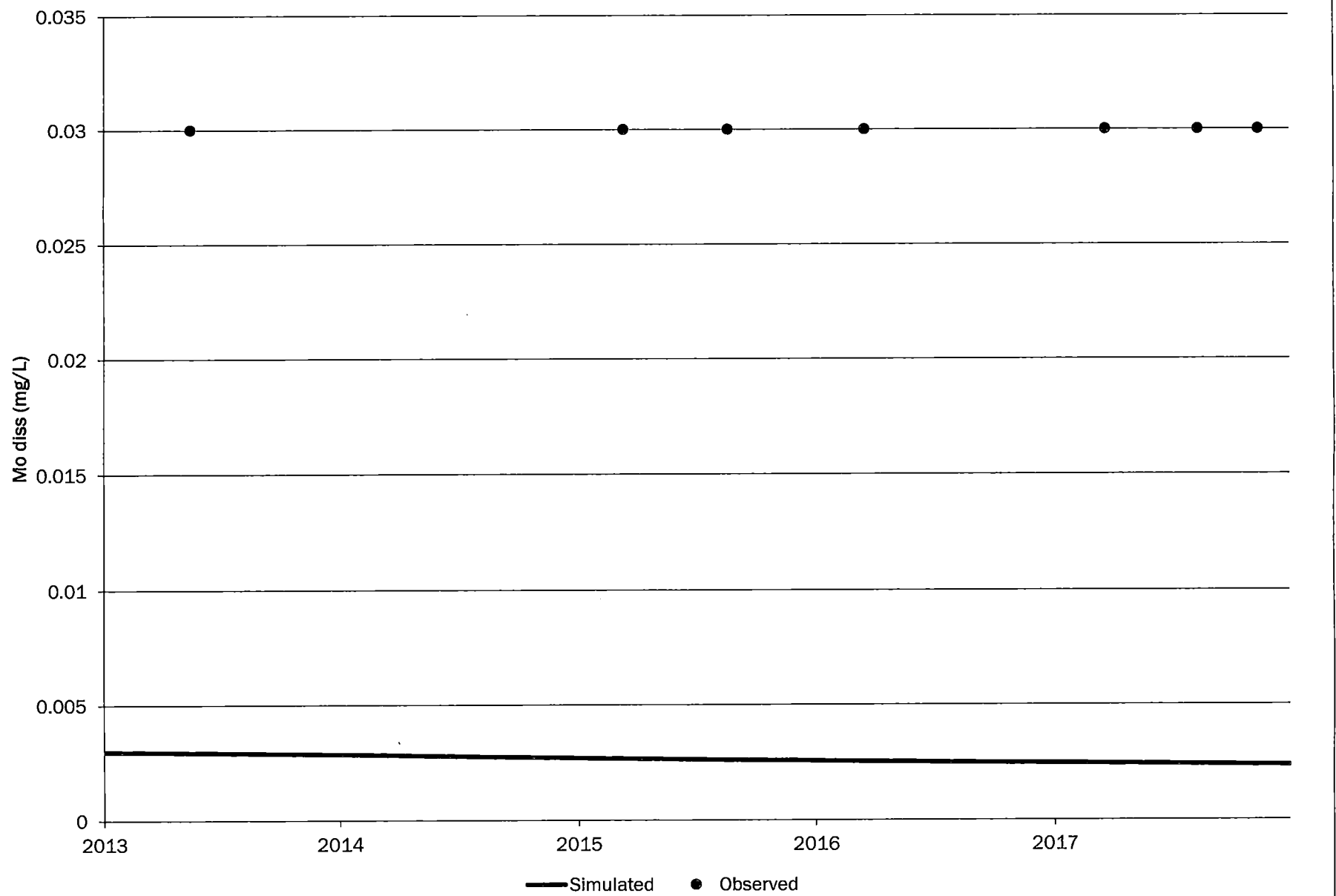
MV-AI



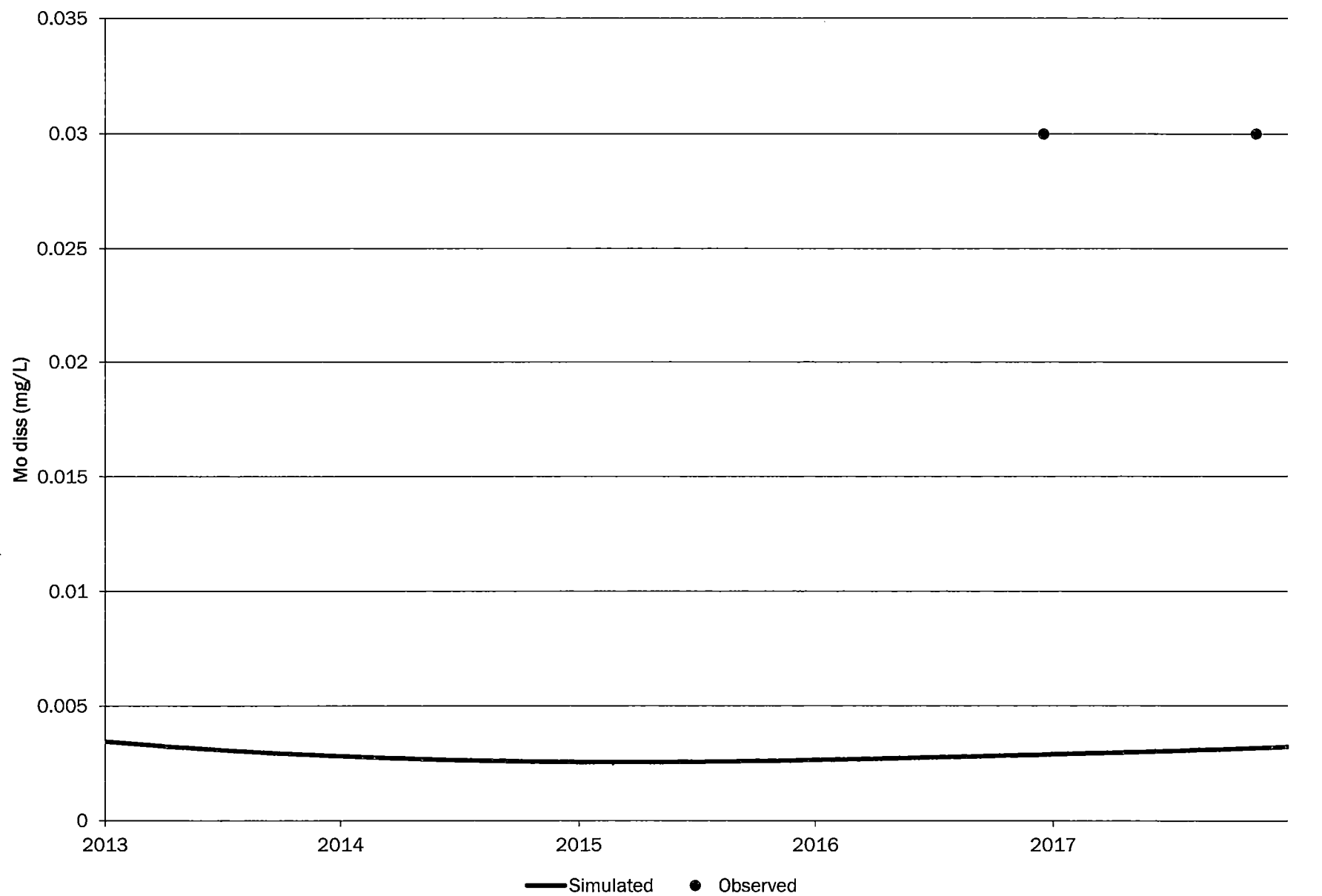
MW-AI



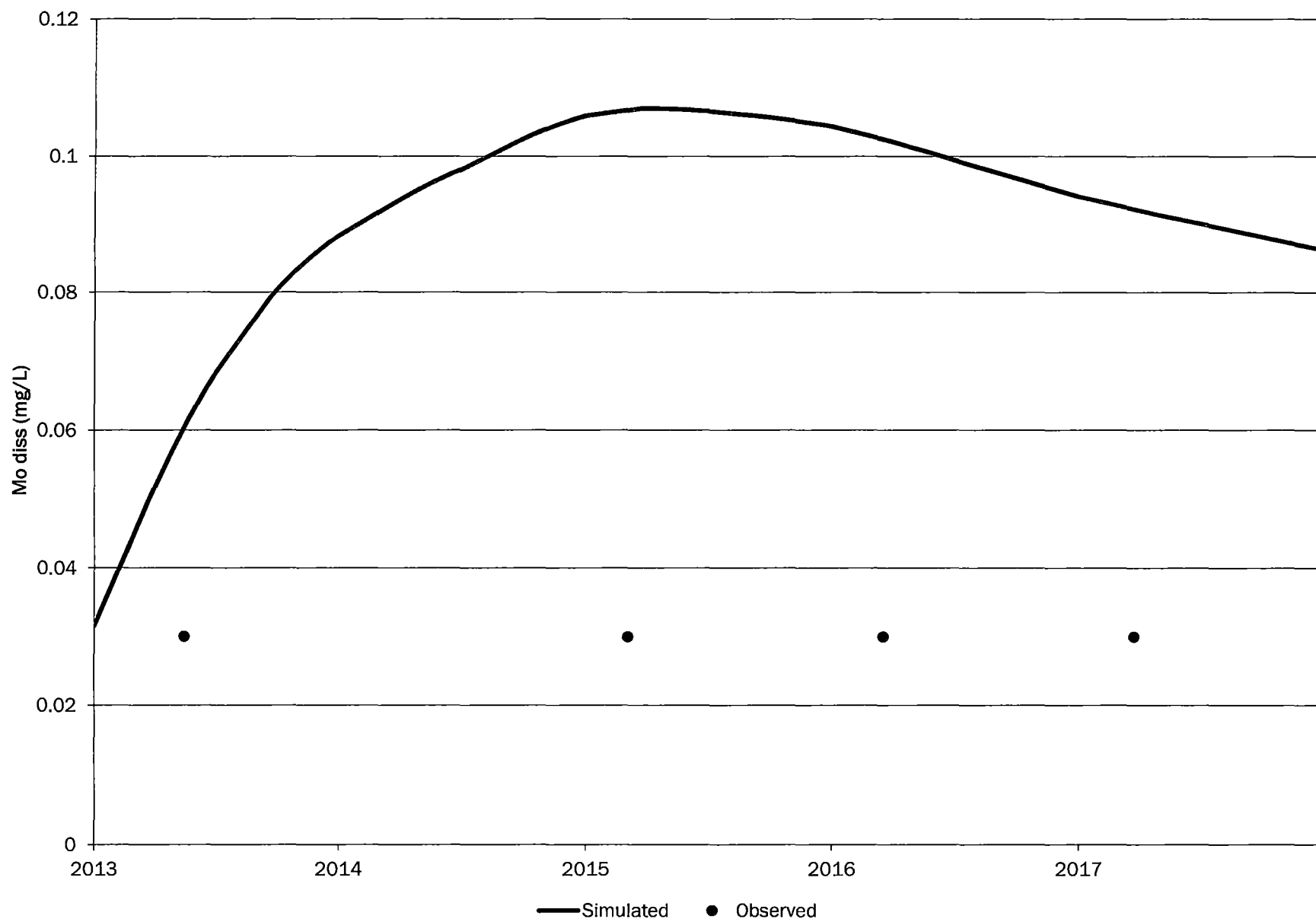
MX-AI



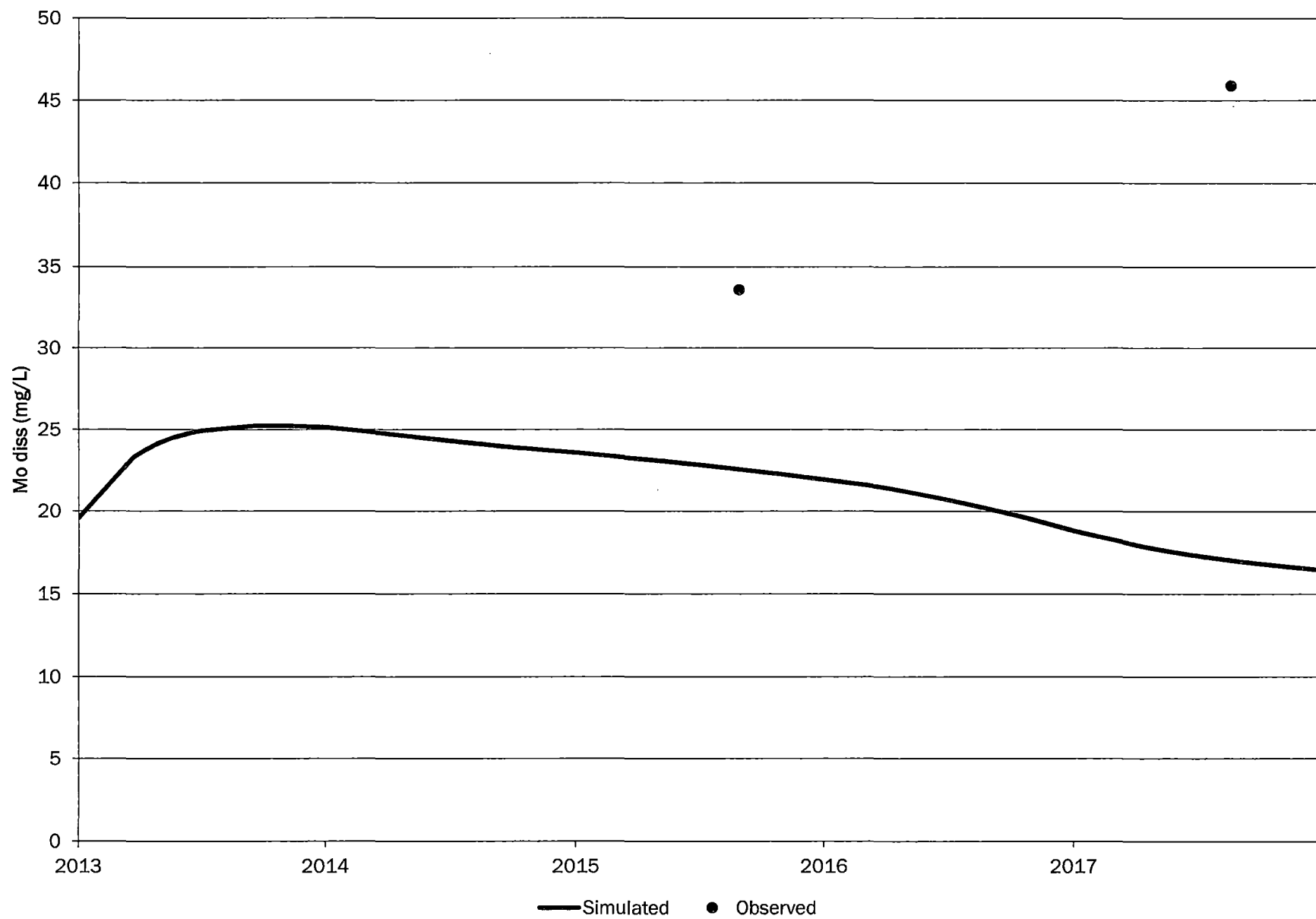
MY-AI



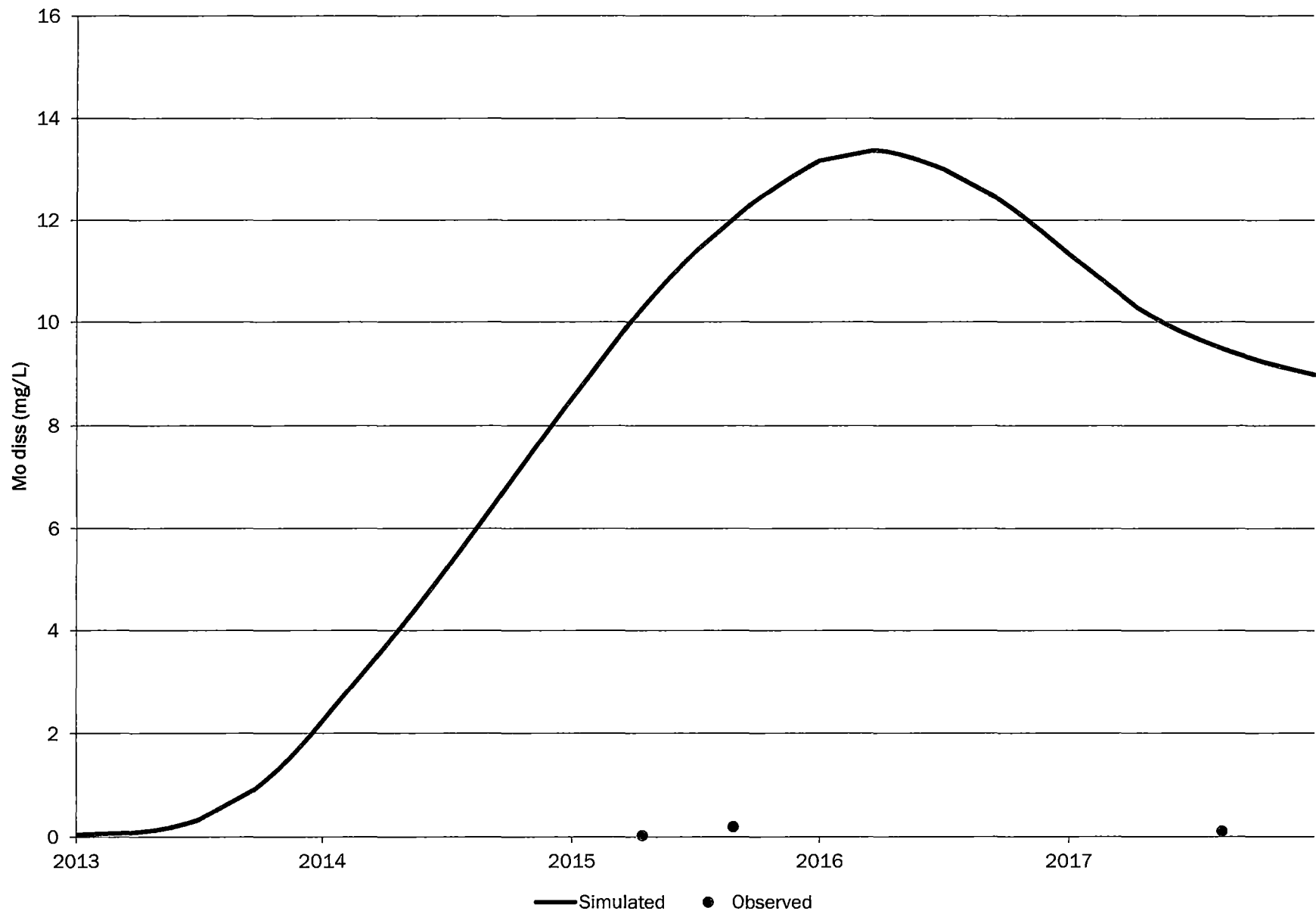
MZ-AI



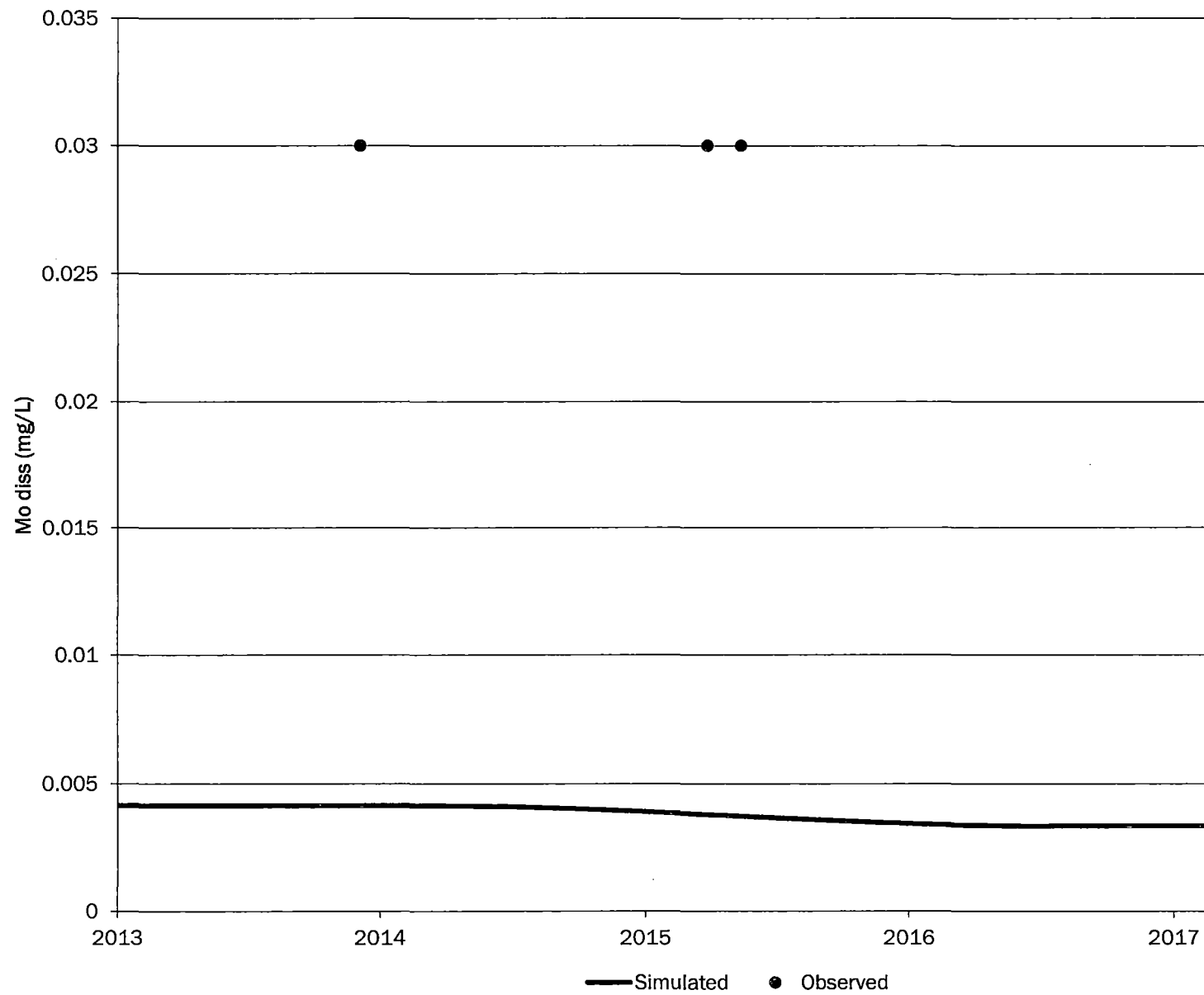
NB-AI



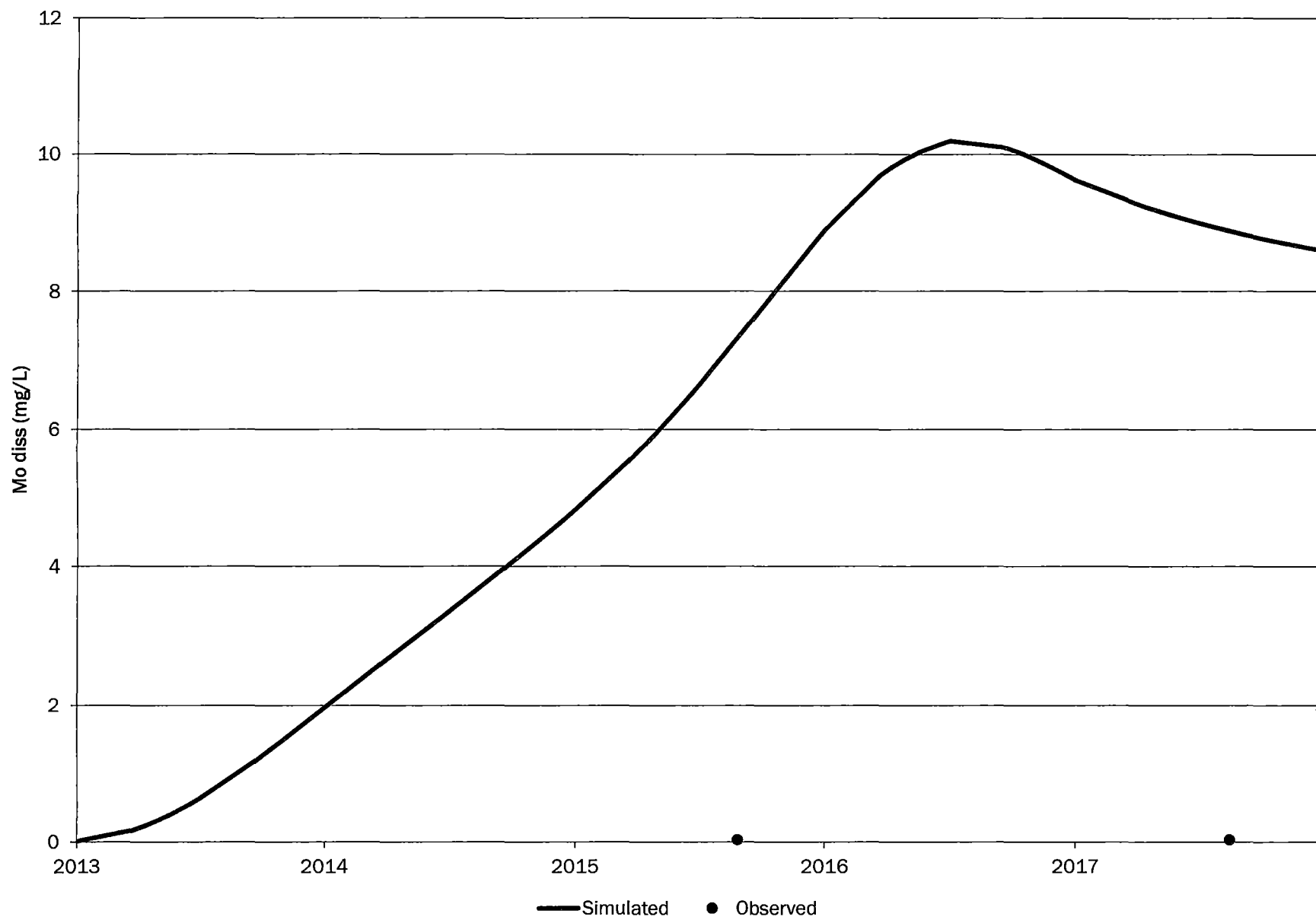
NC-AI



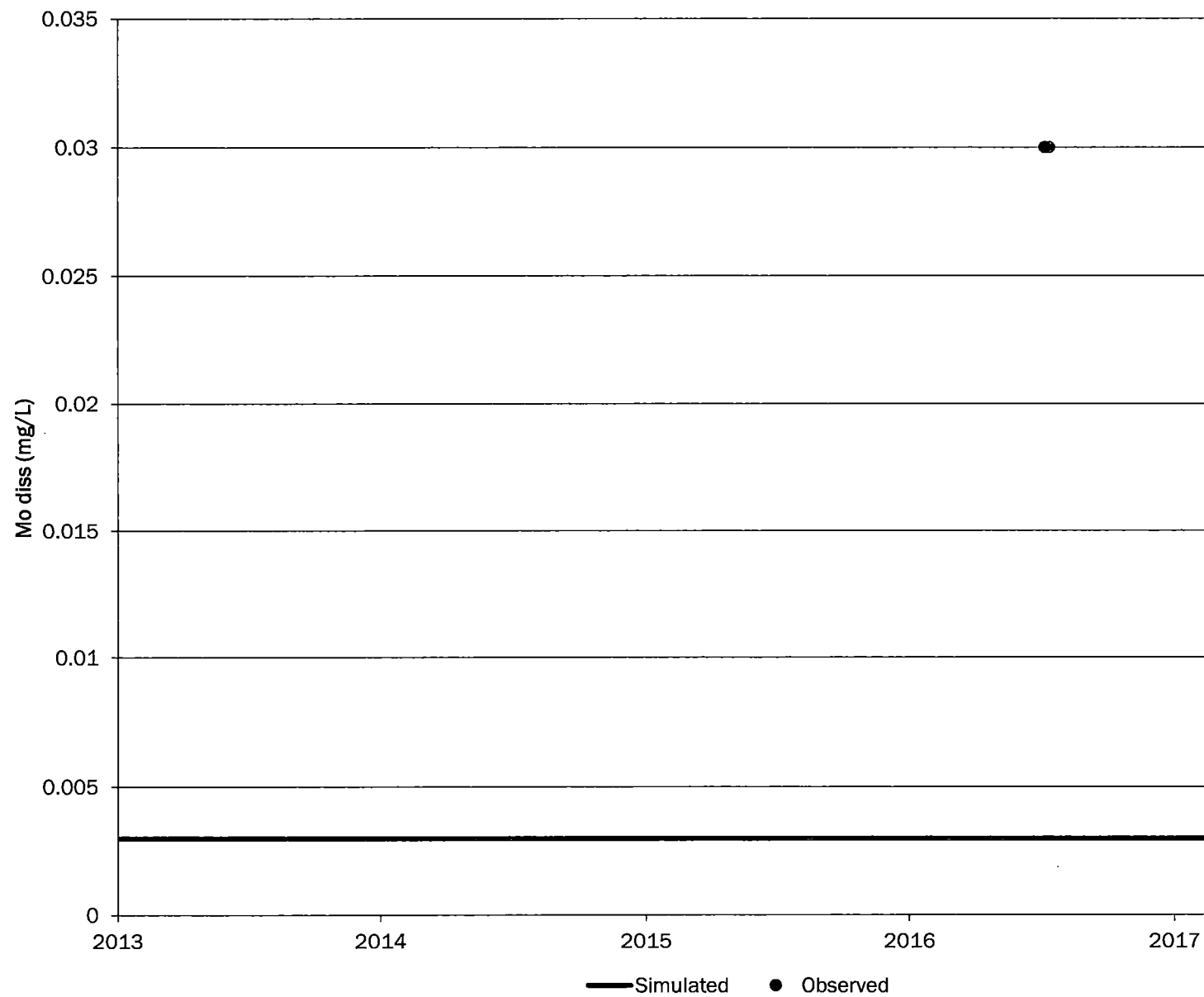
ND-AI



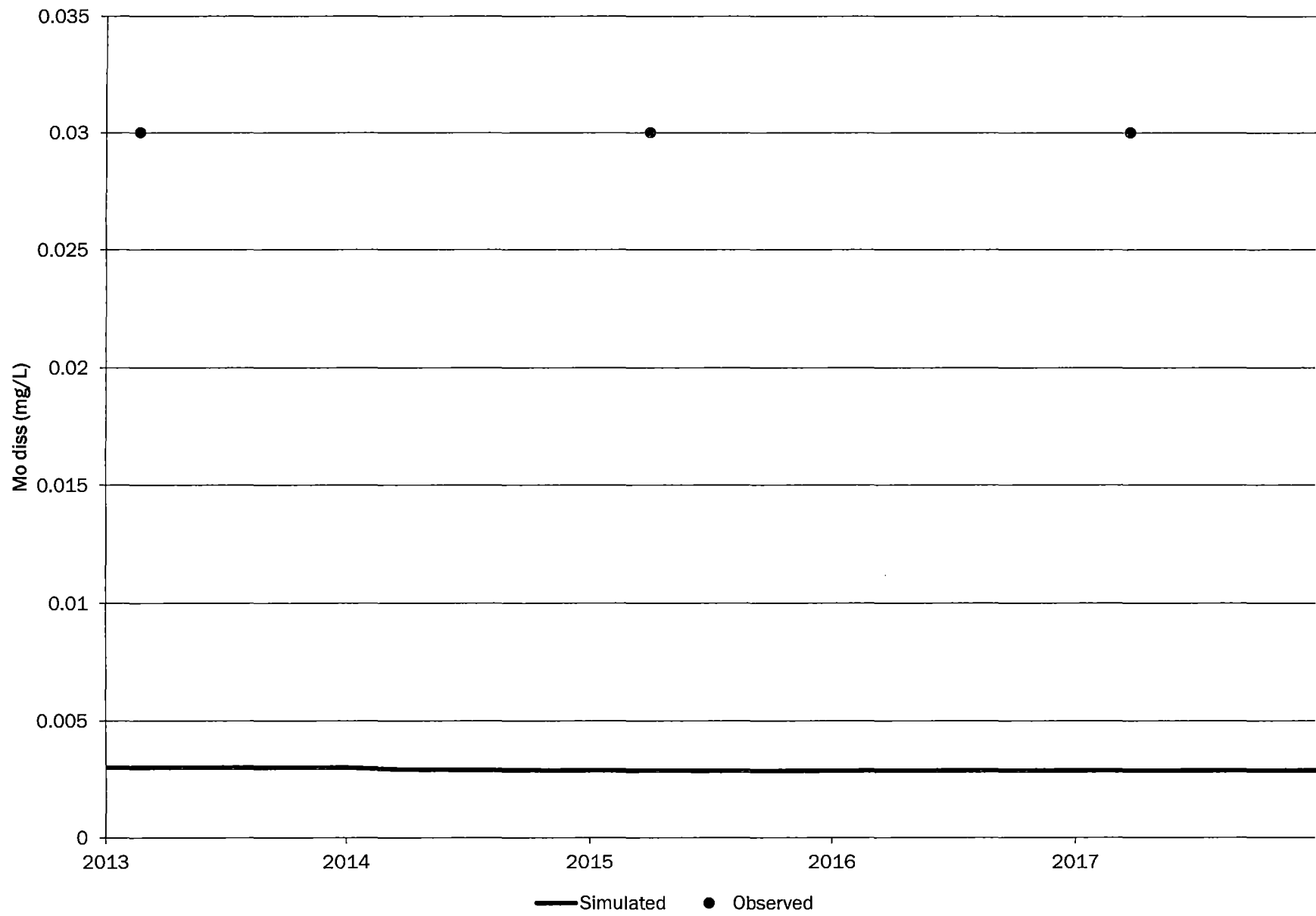
O-Al



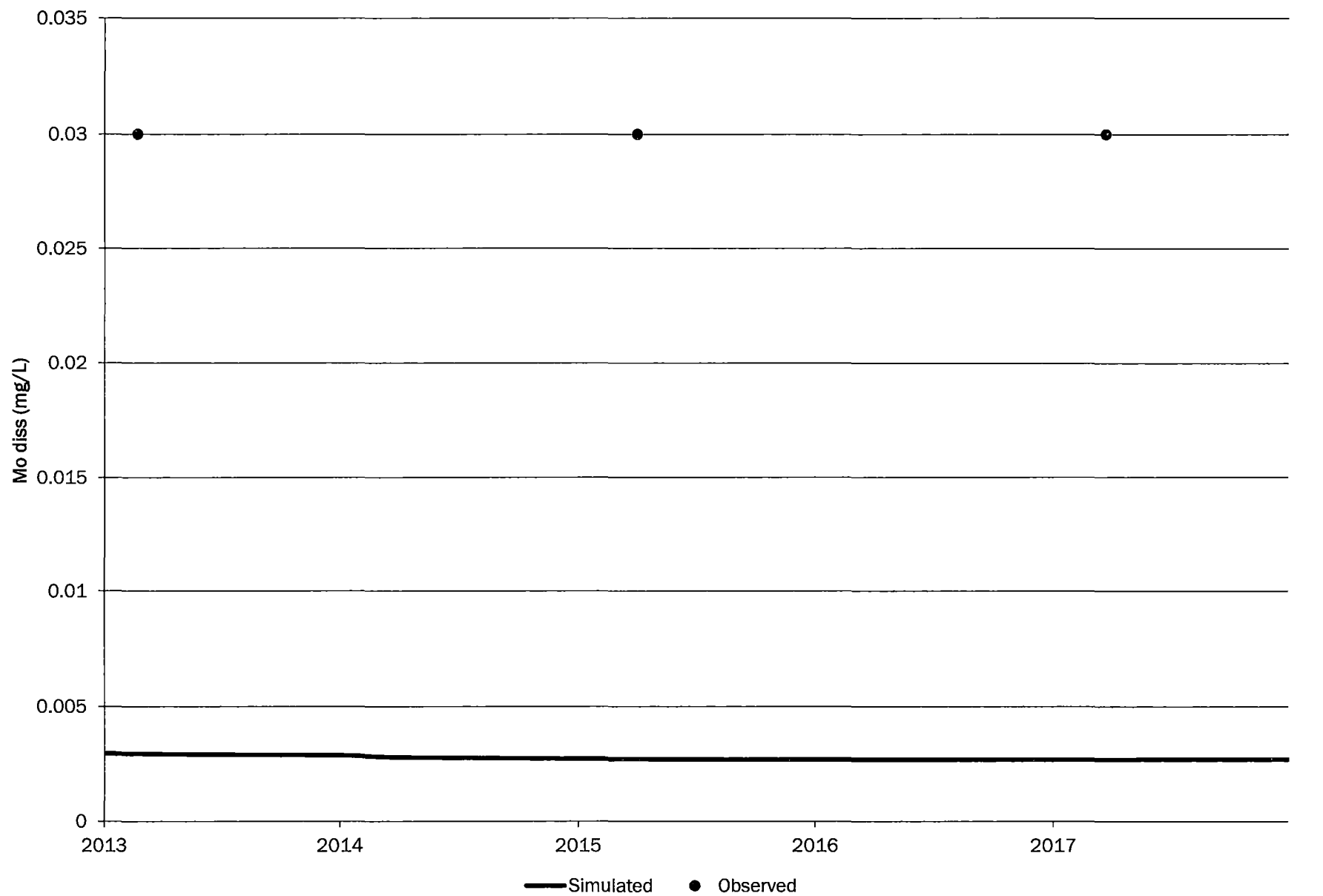
OLD #1-SA



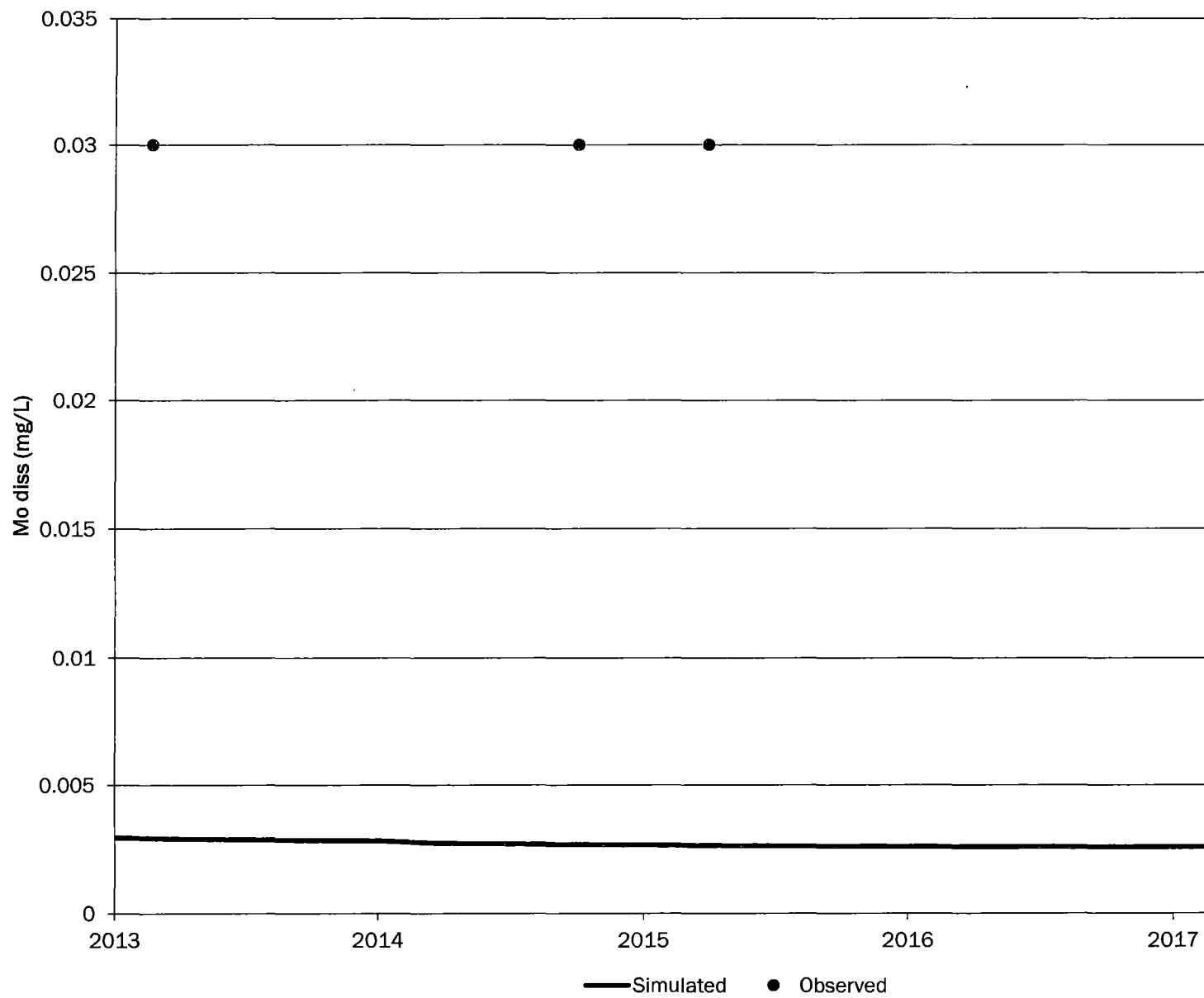
P2-AI



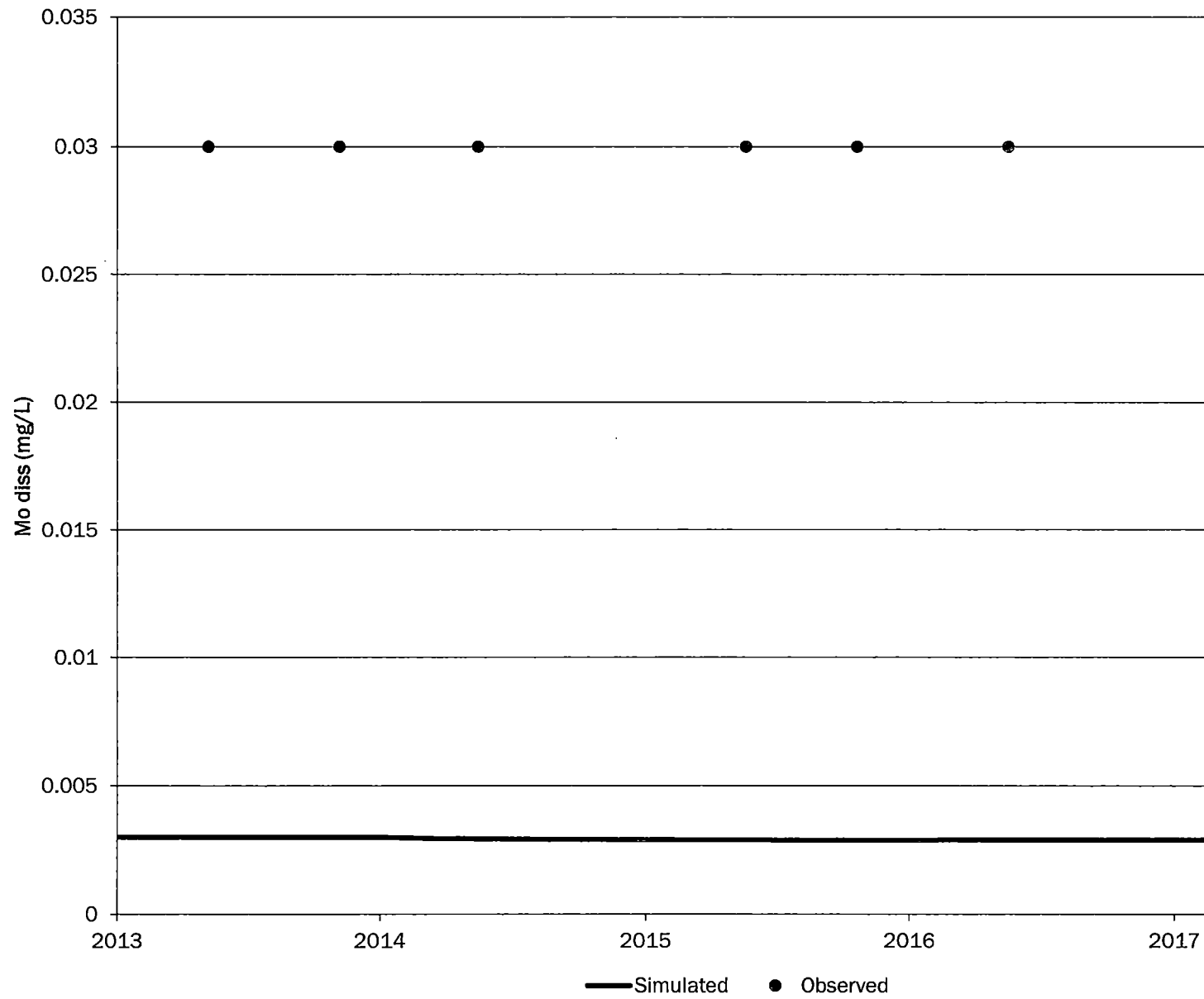
P3-AI



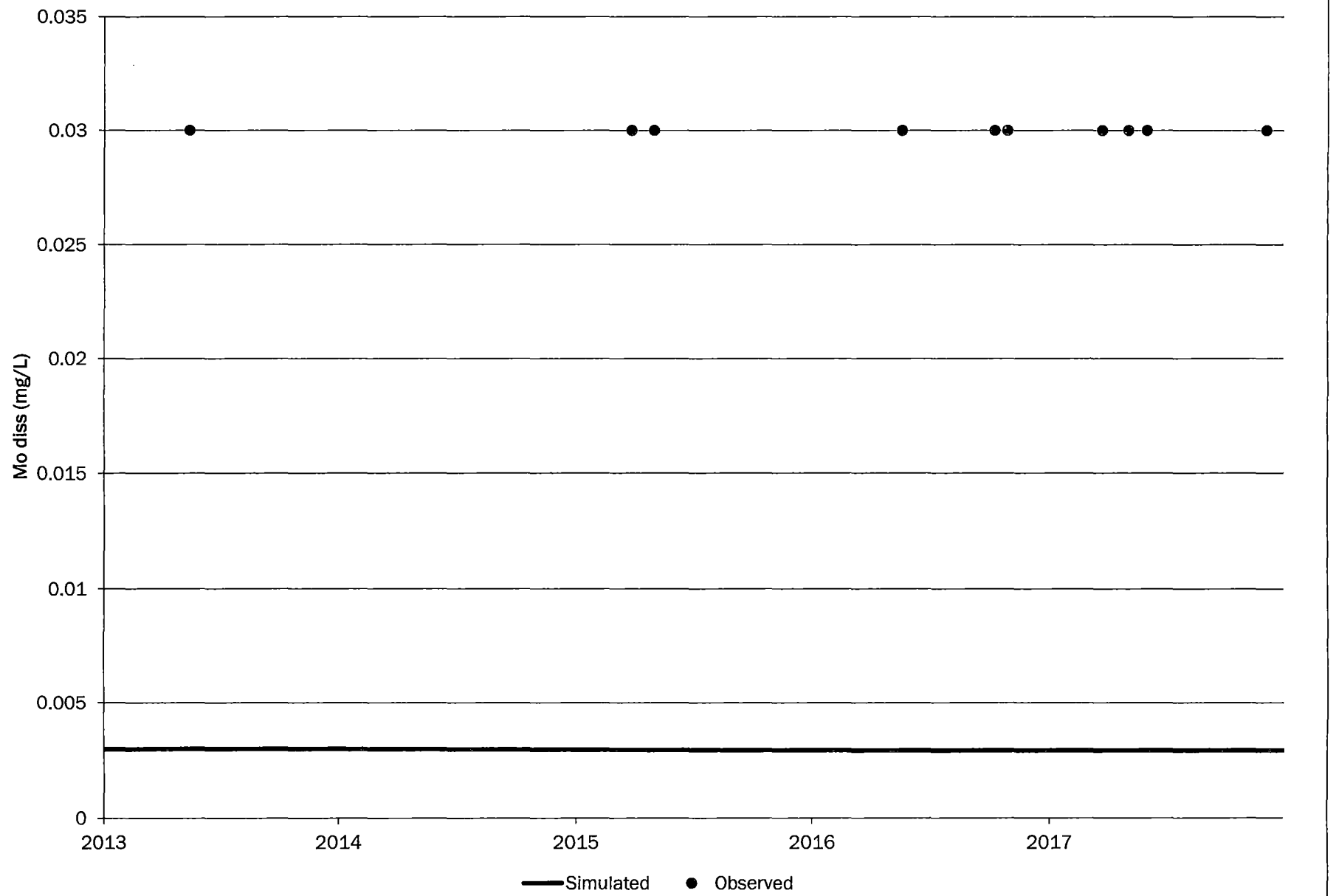
P4-AI



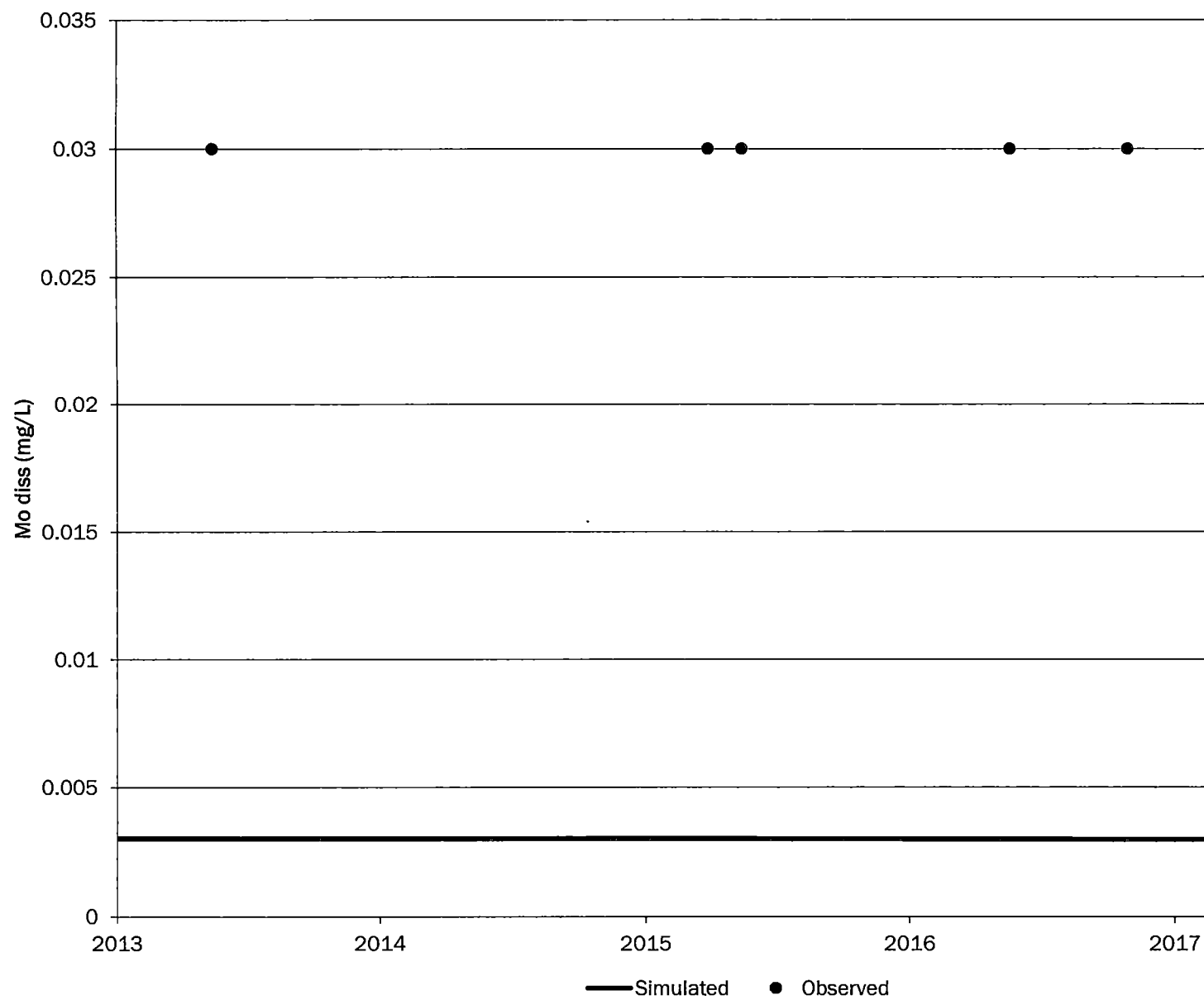
P-AI



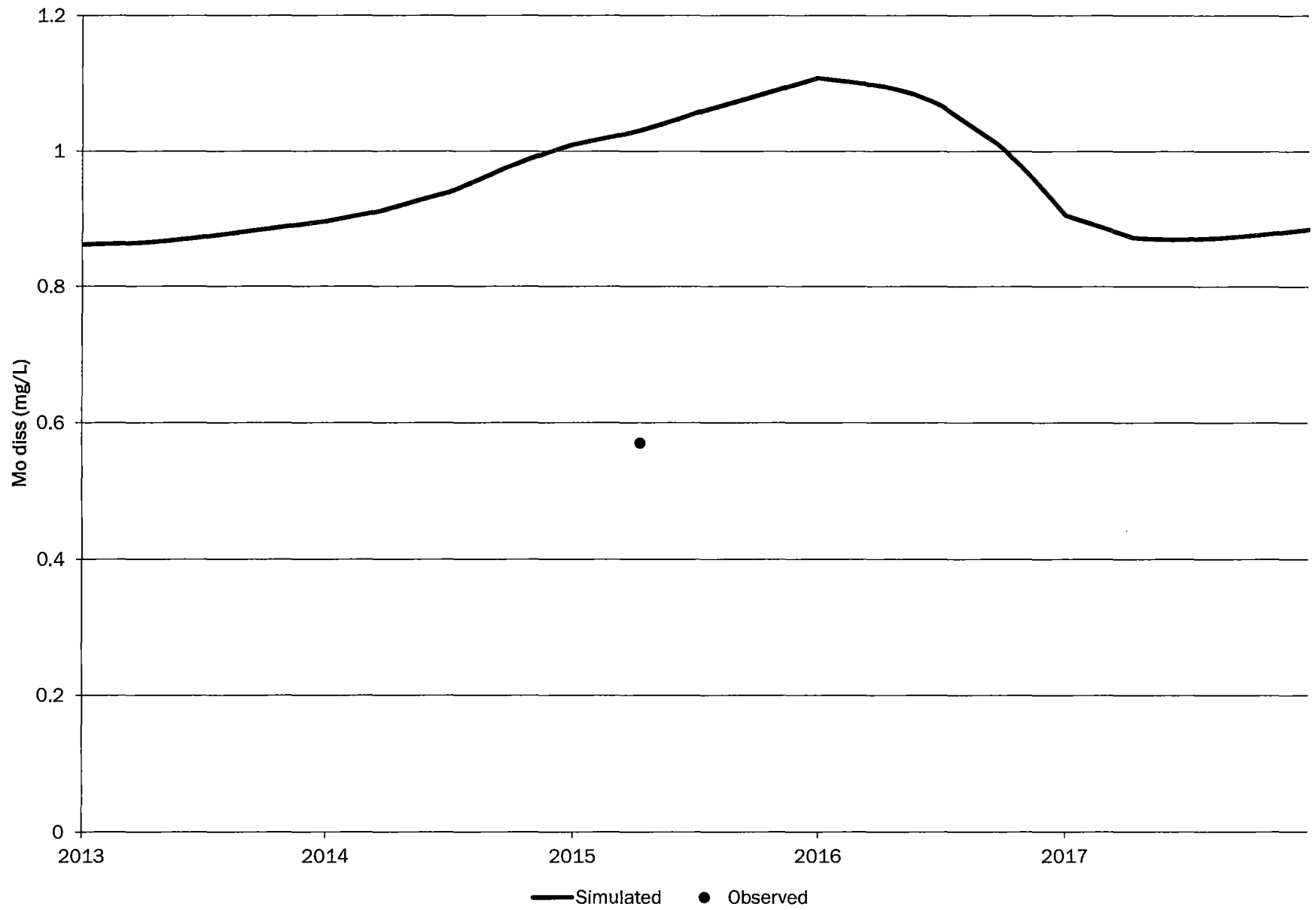
Q-AI



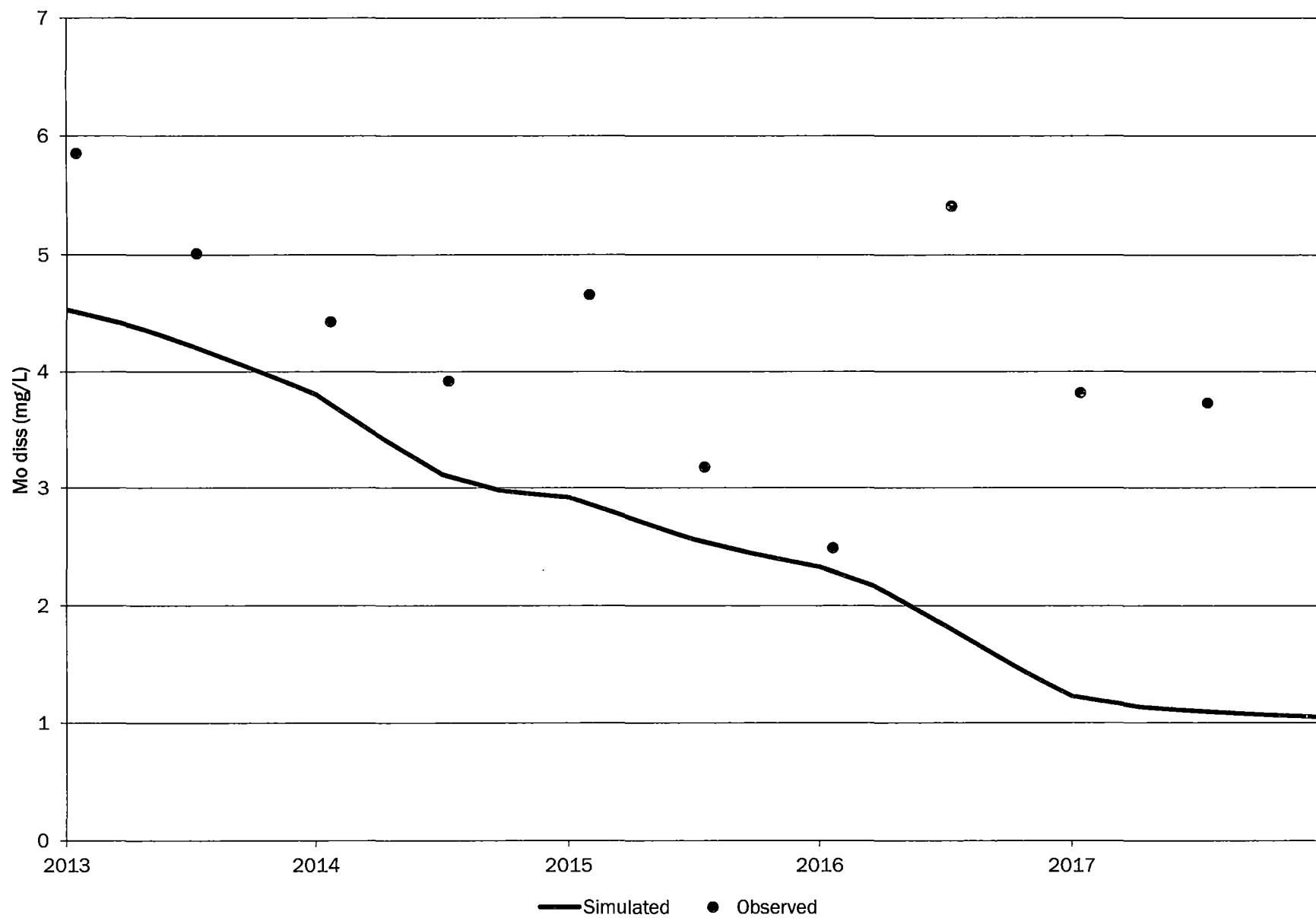
R-AI



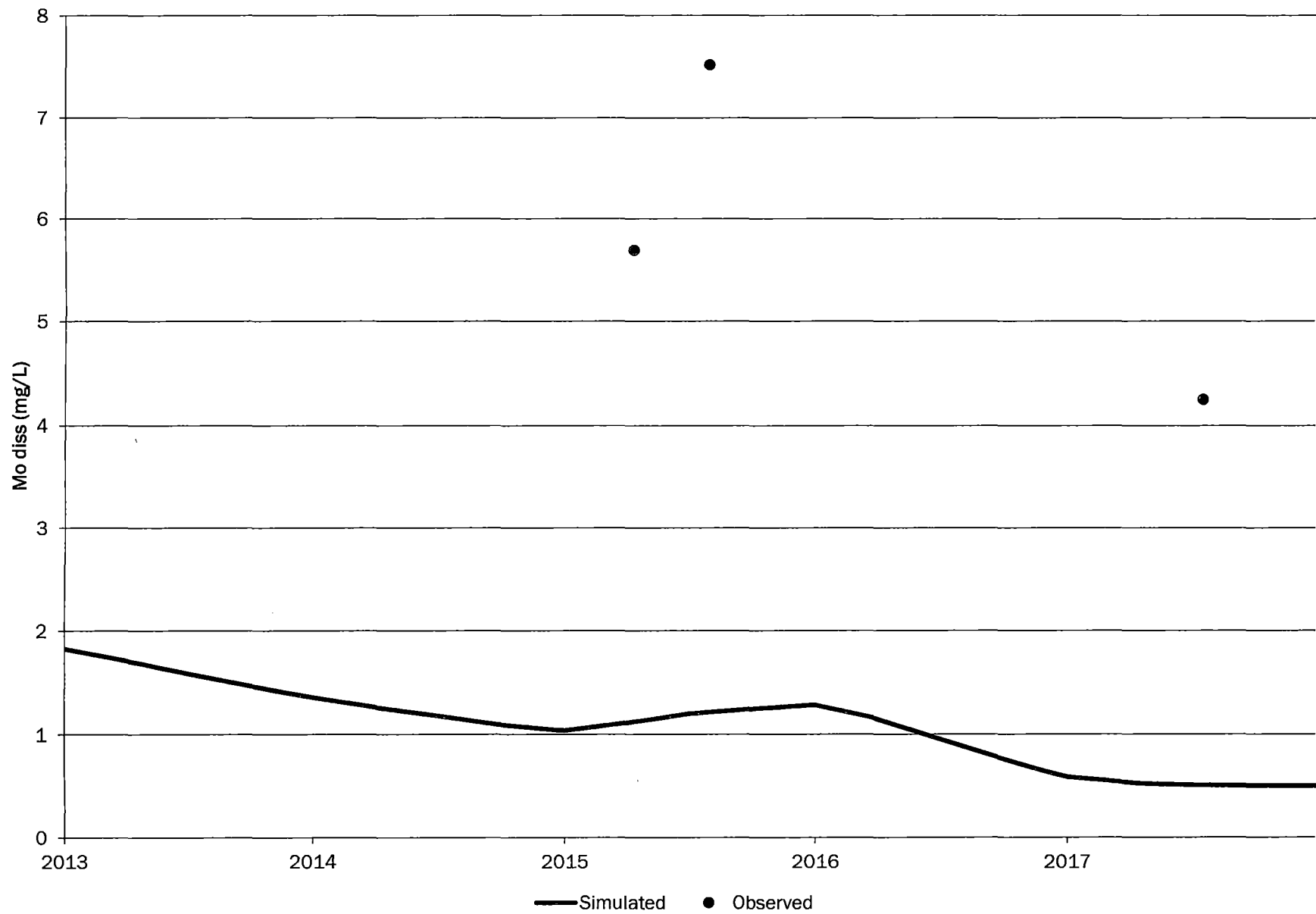
S1-AI



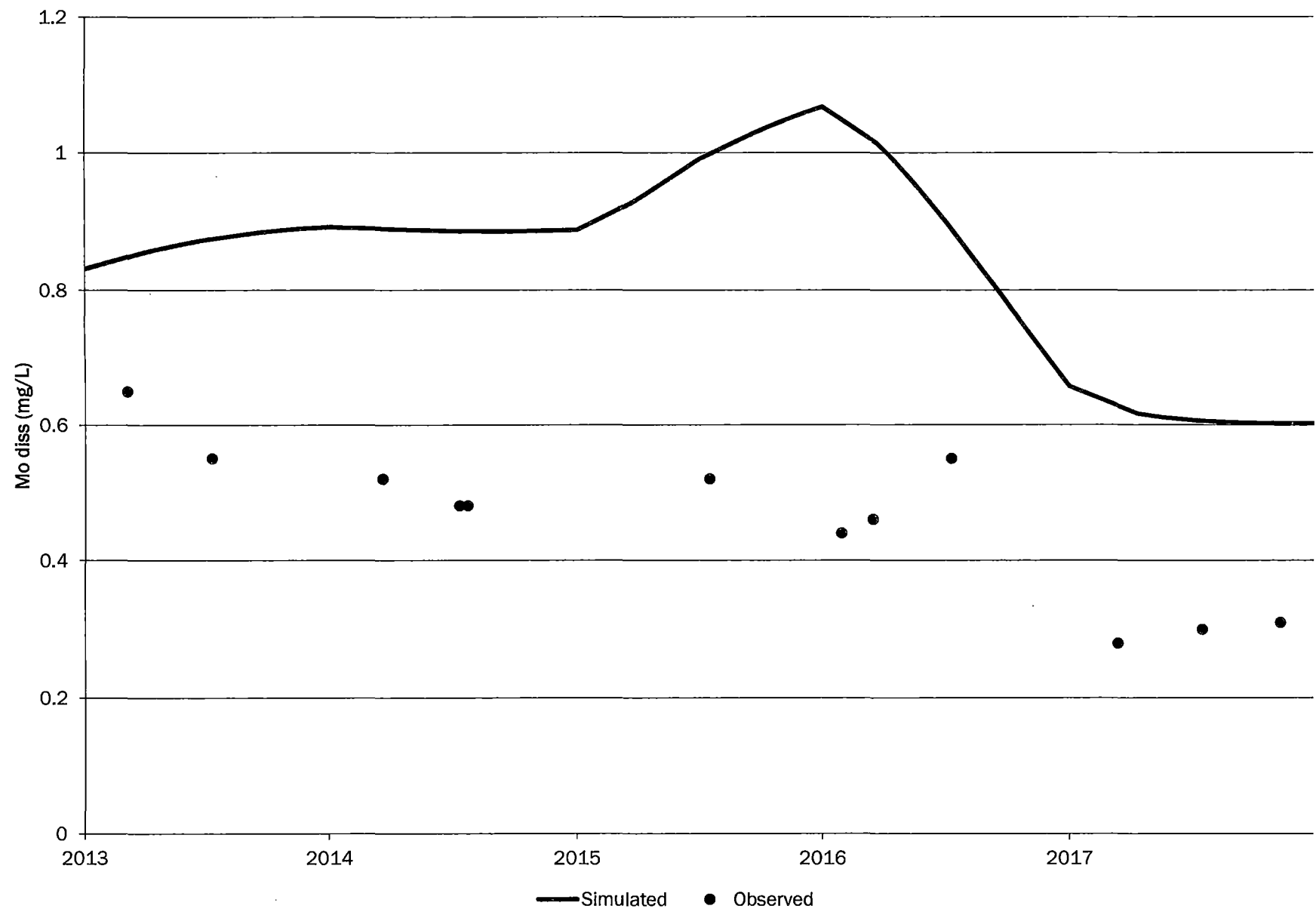
S2-AI



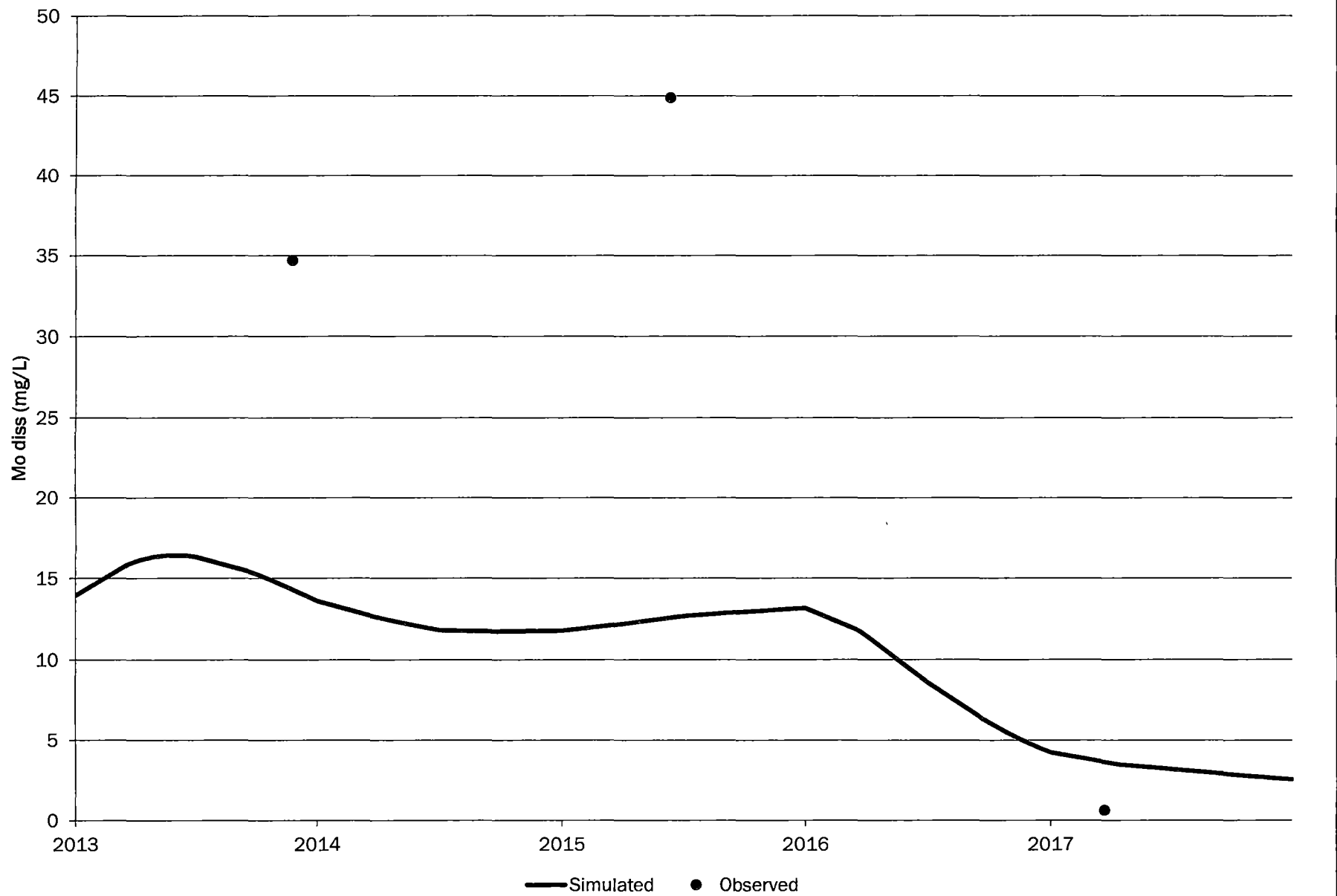
S3-AI



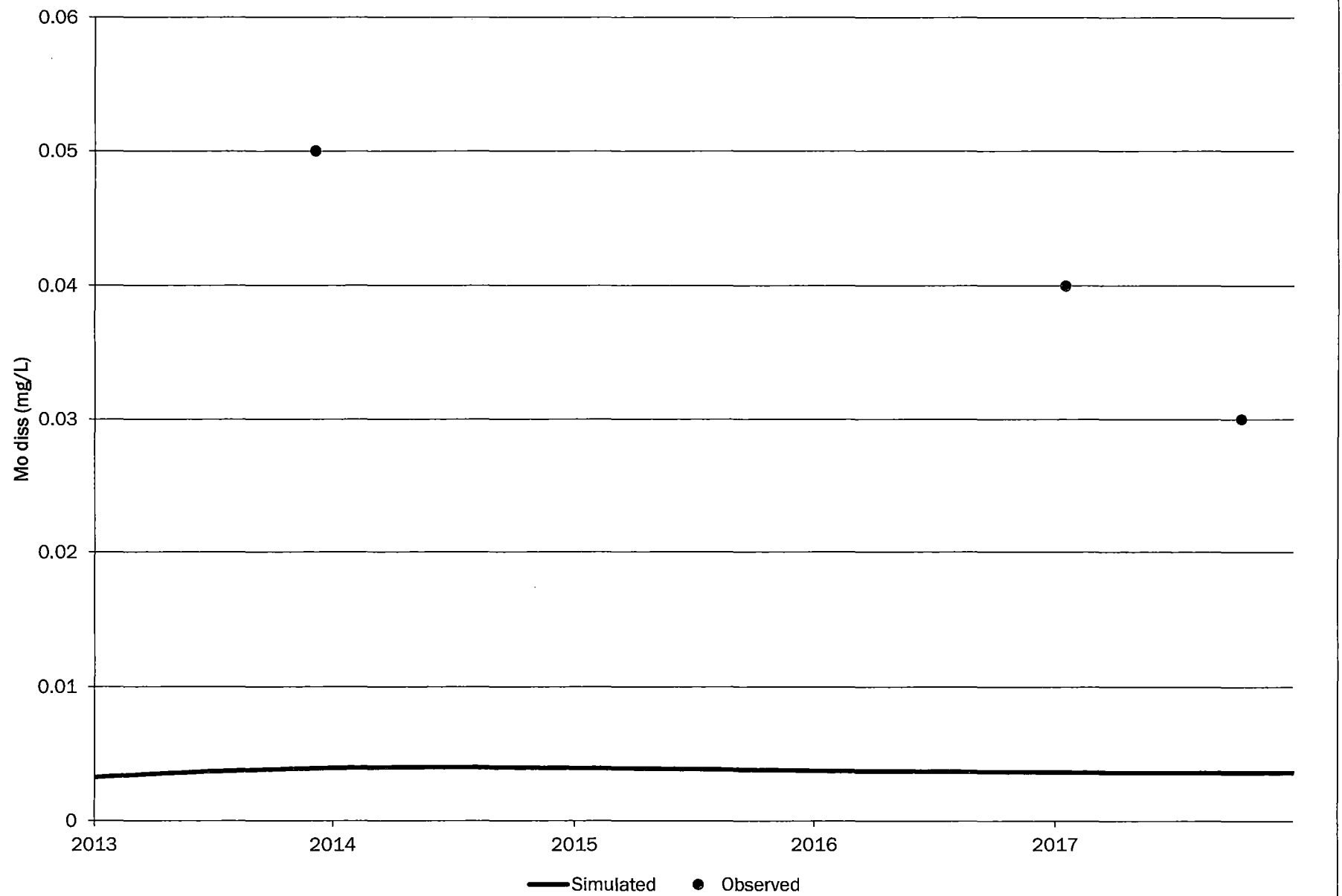
S4-AI



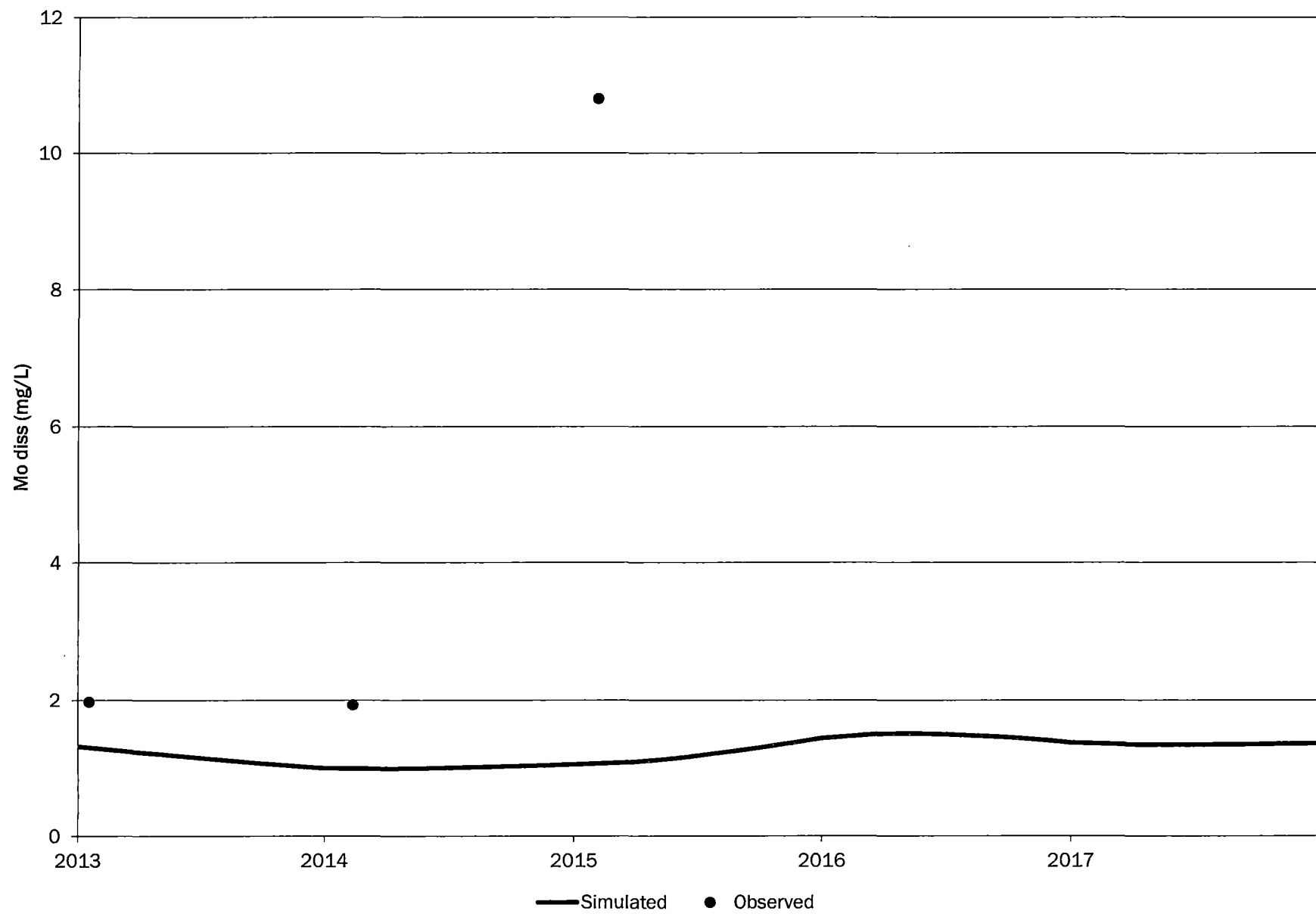
S5R-AI



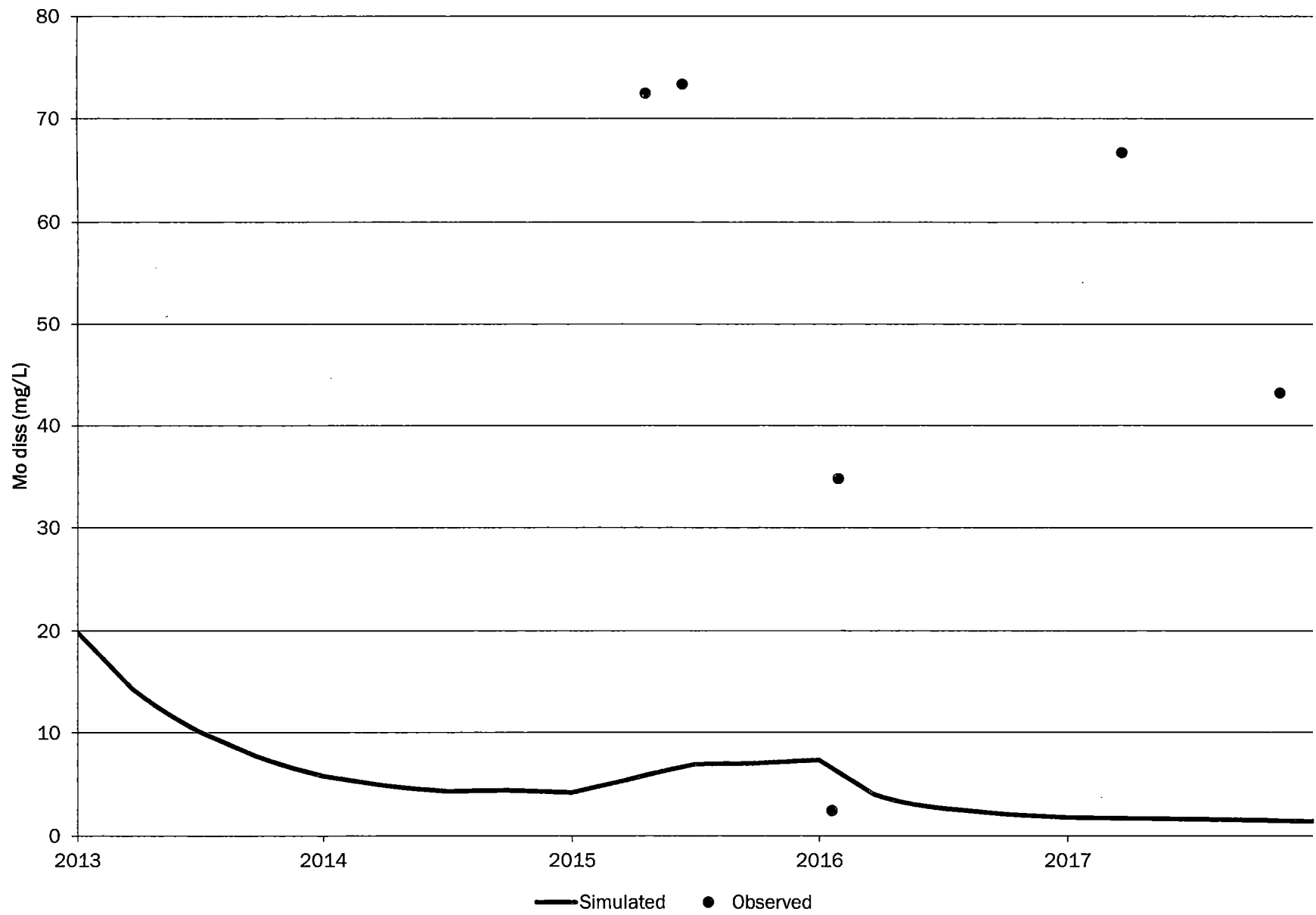
S11-AI



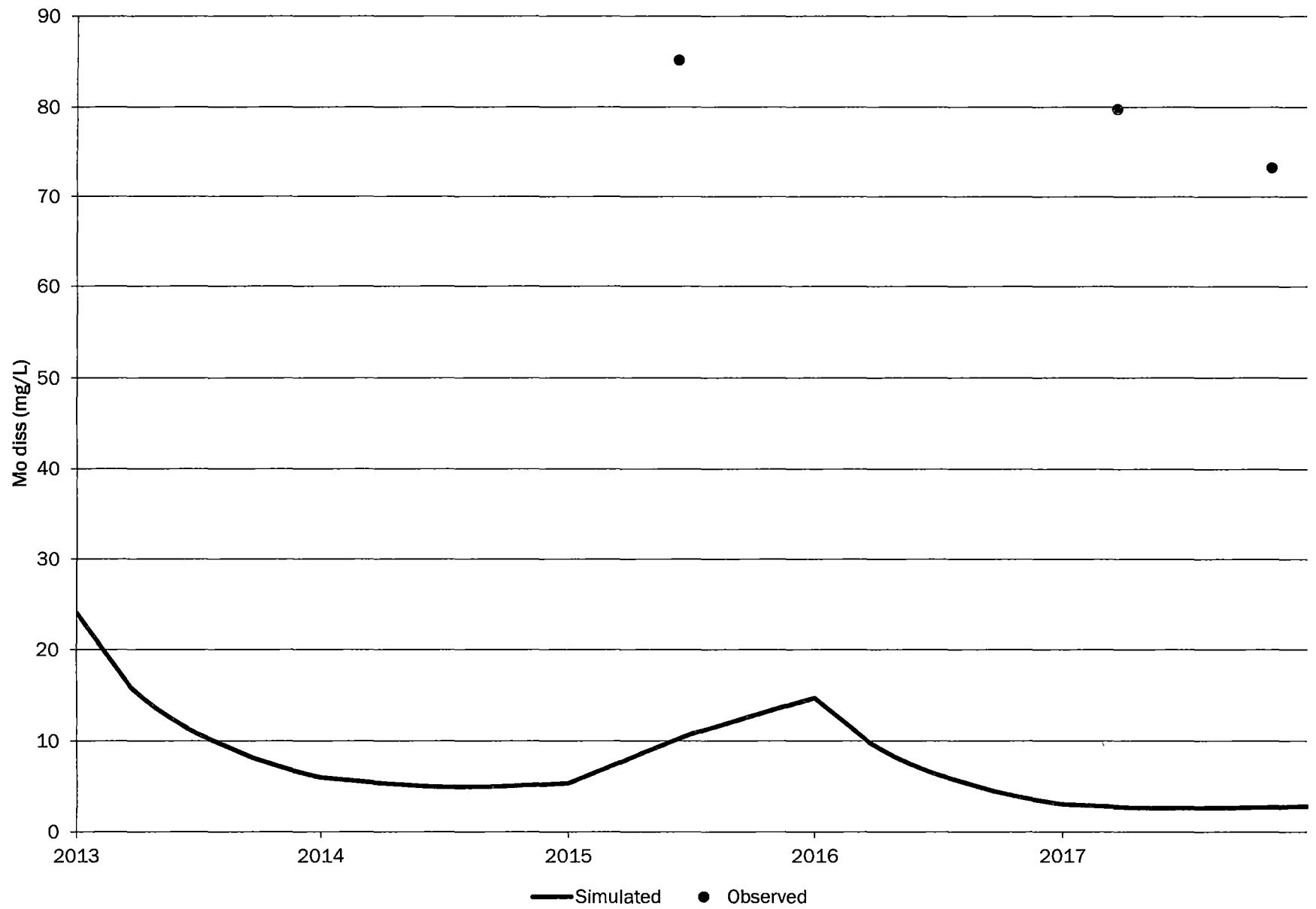
S12-AI



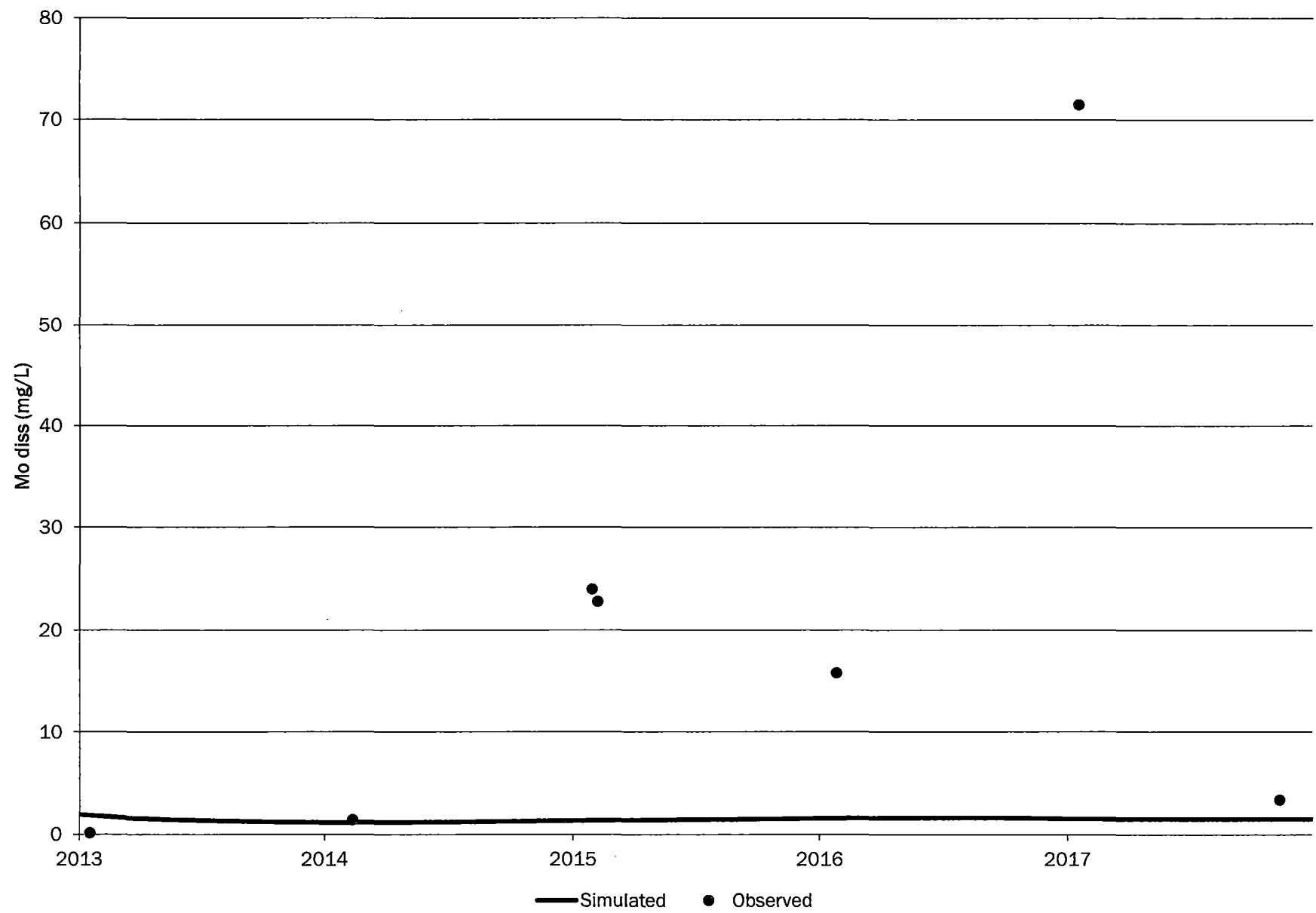
SA-AI



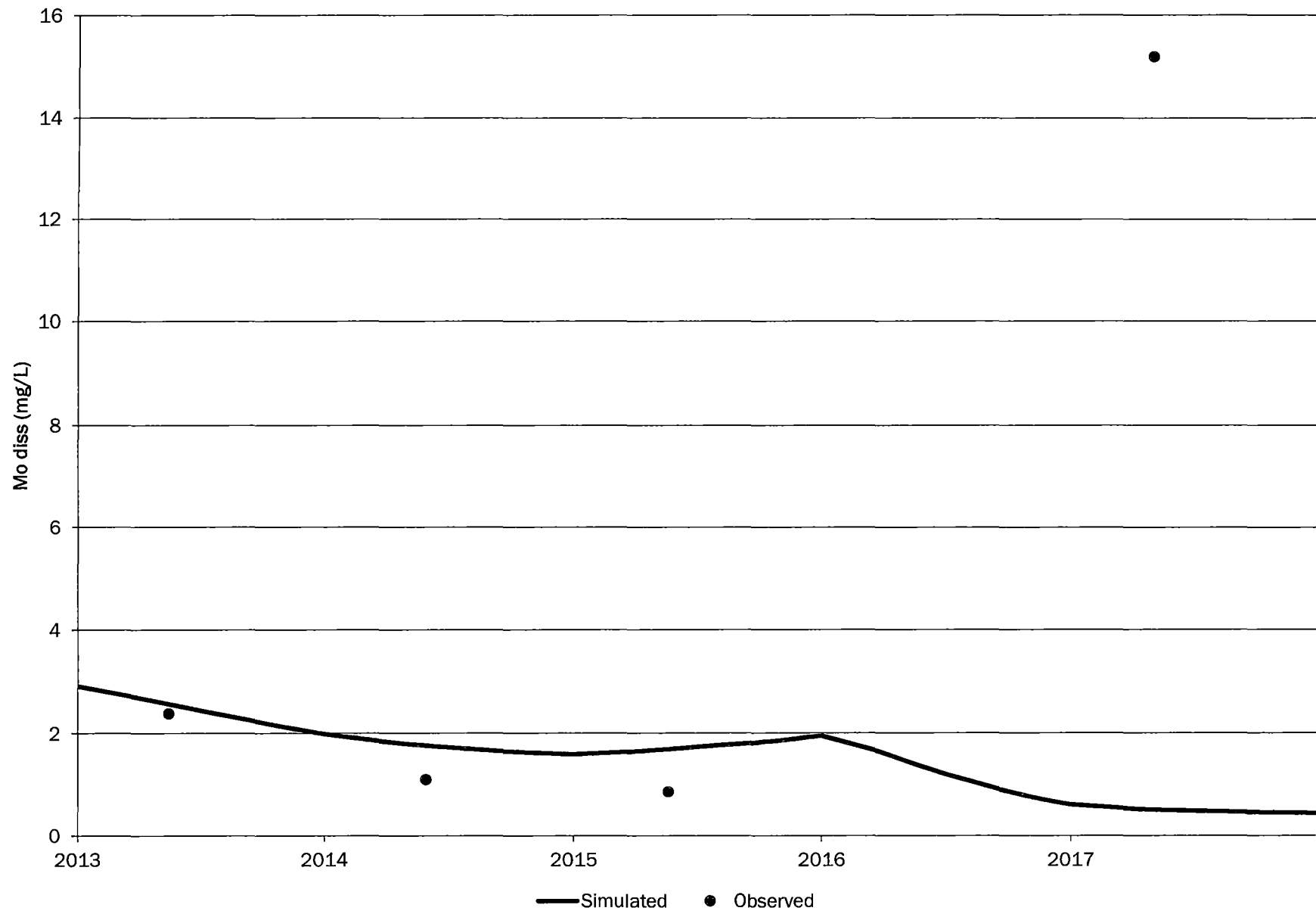
SB-AI



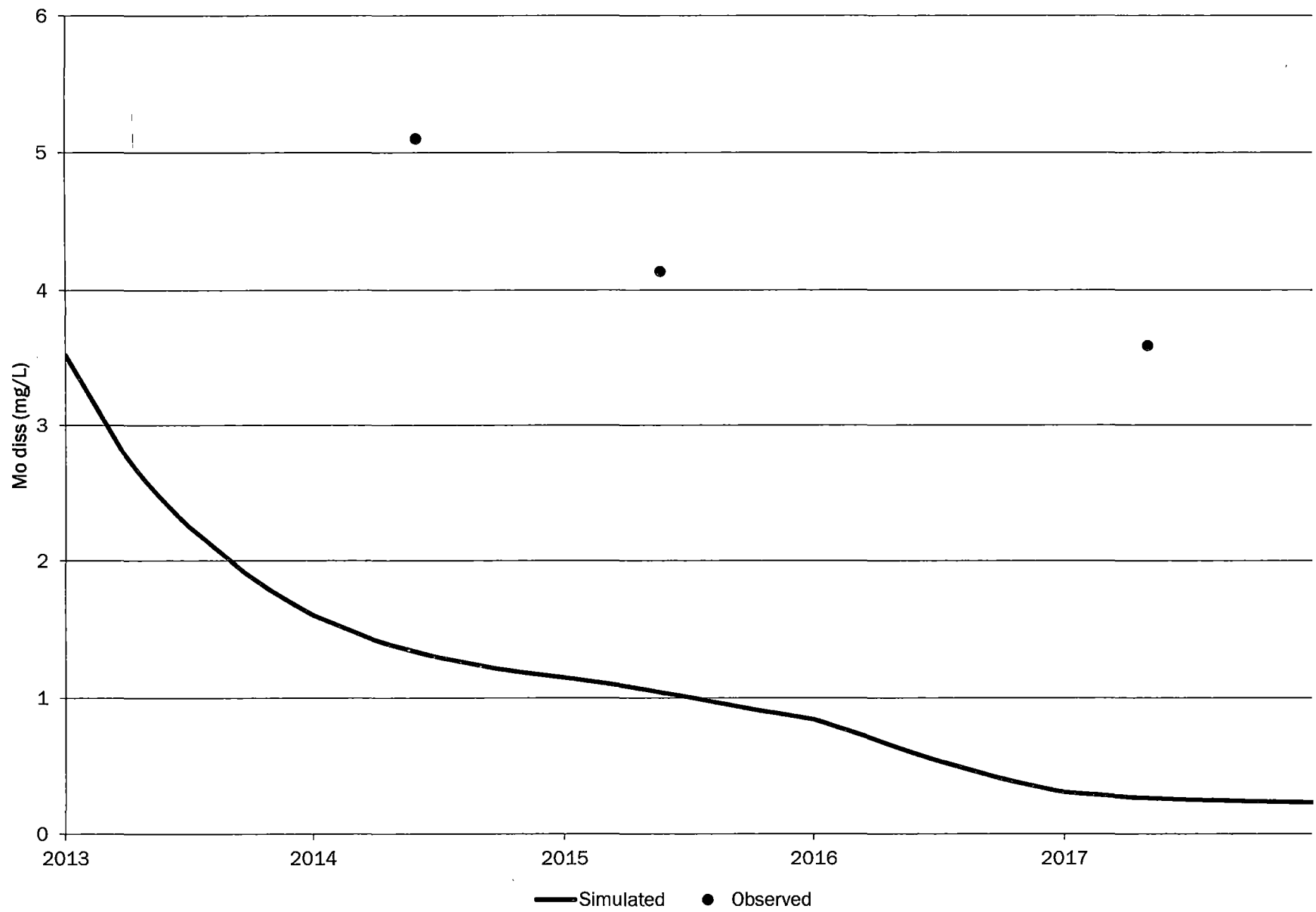
SE6-AI



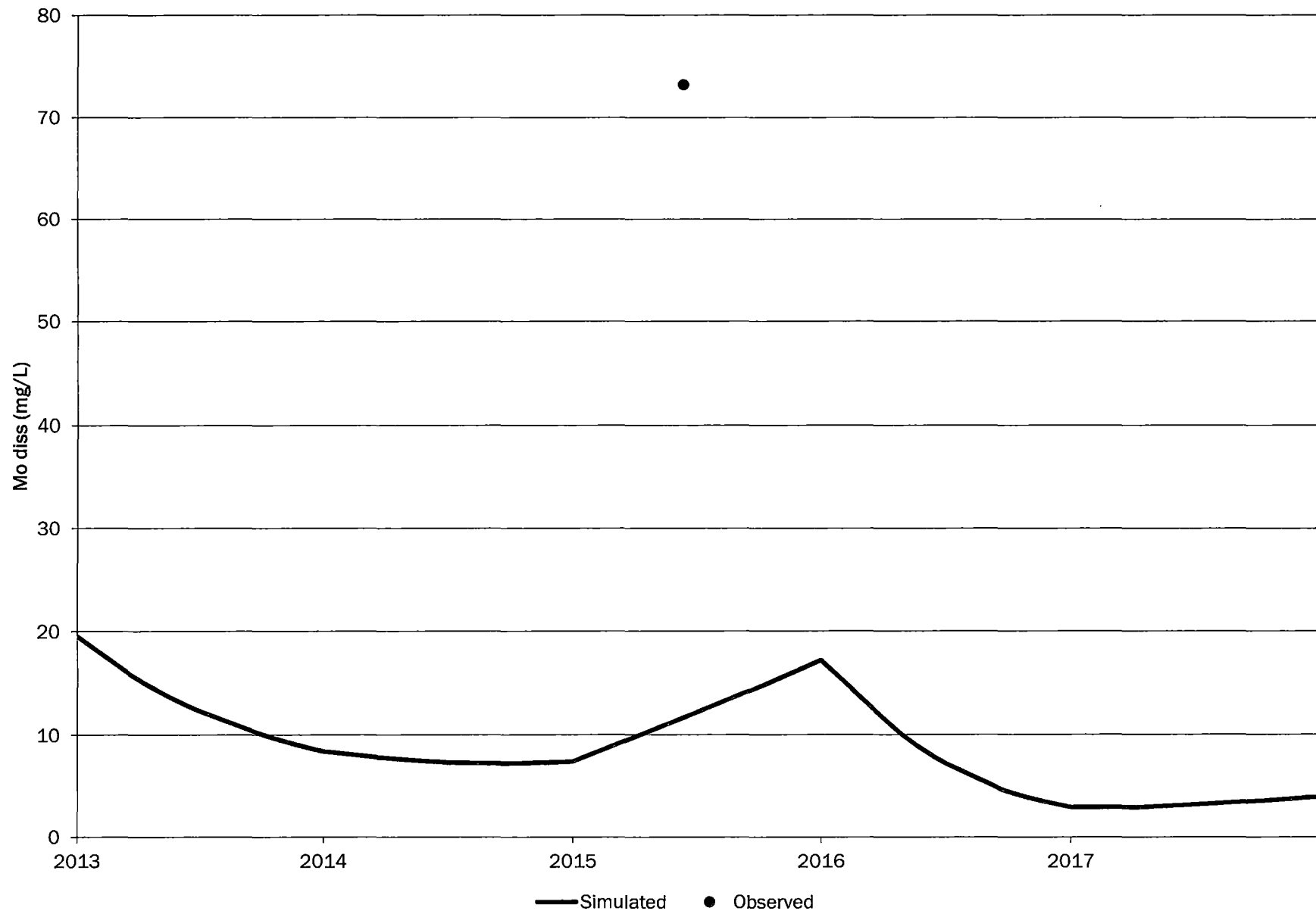
SM-AI



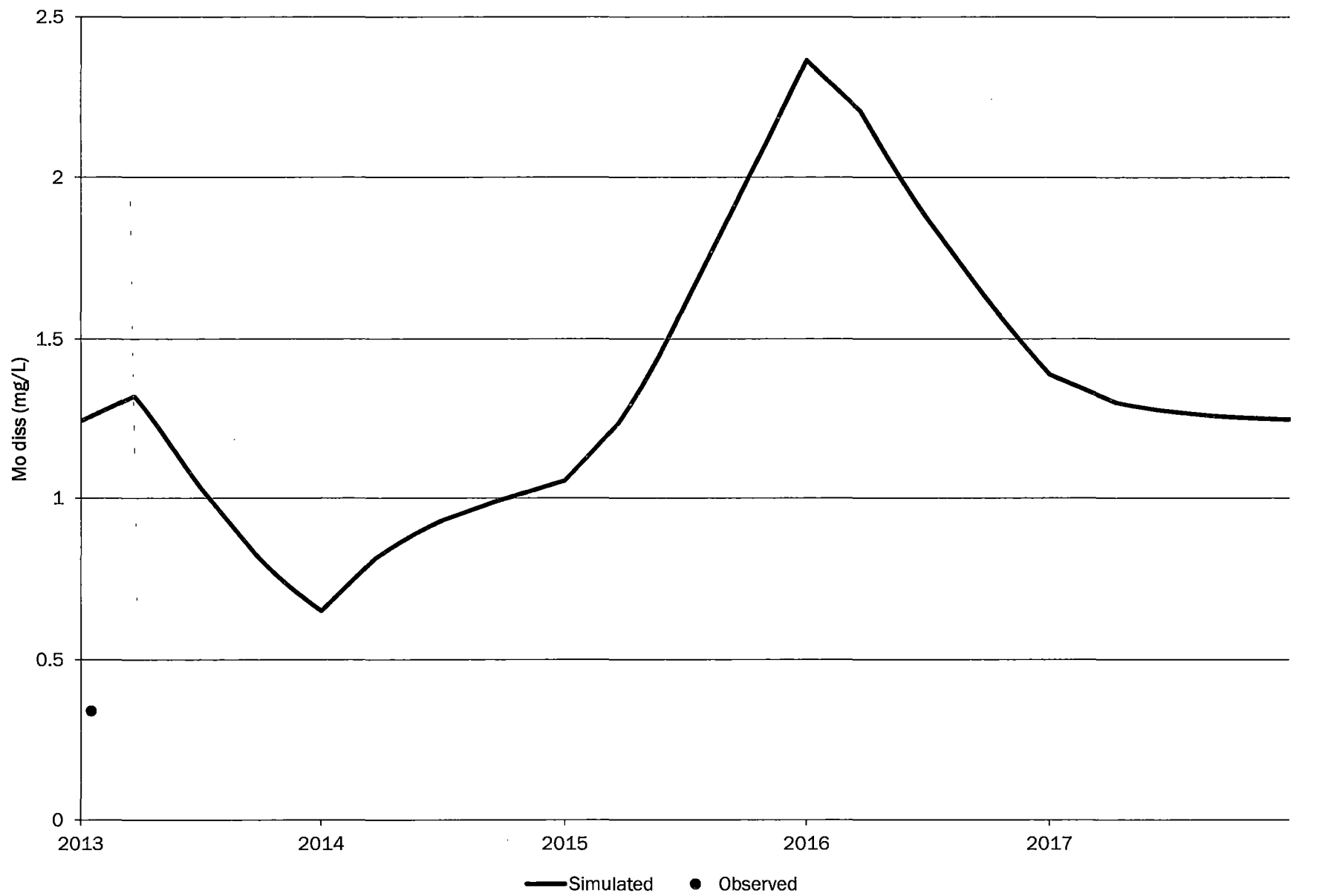
SO-AI



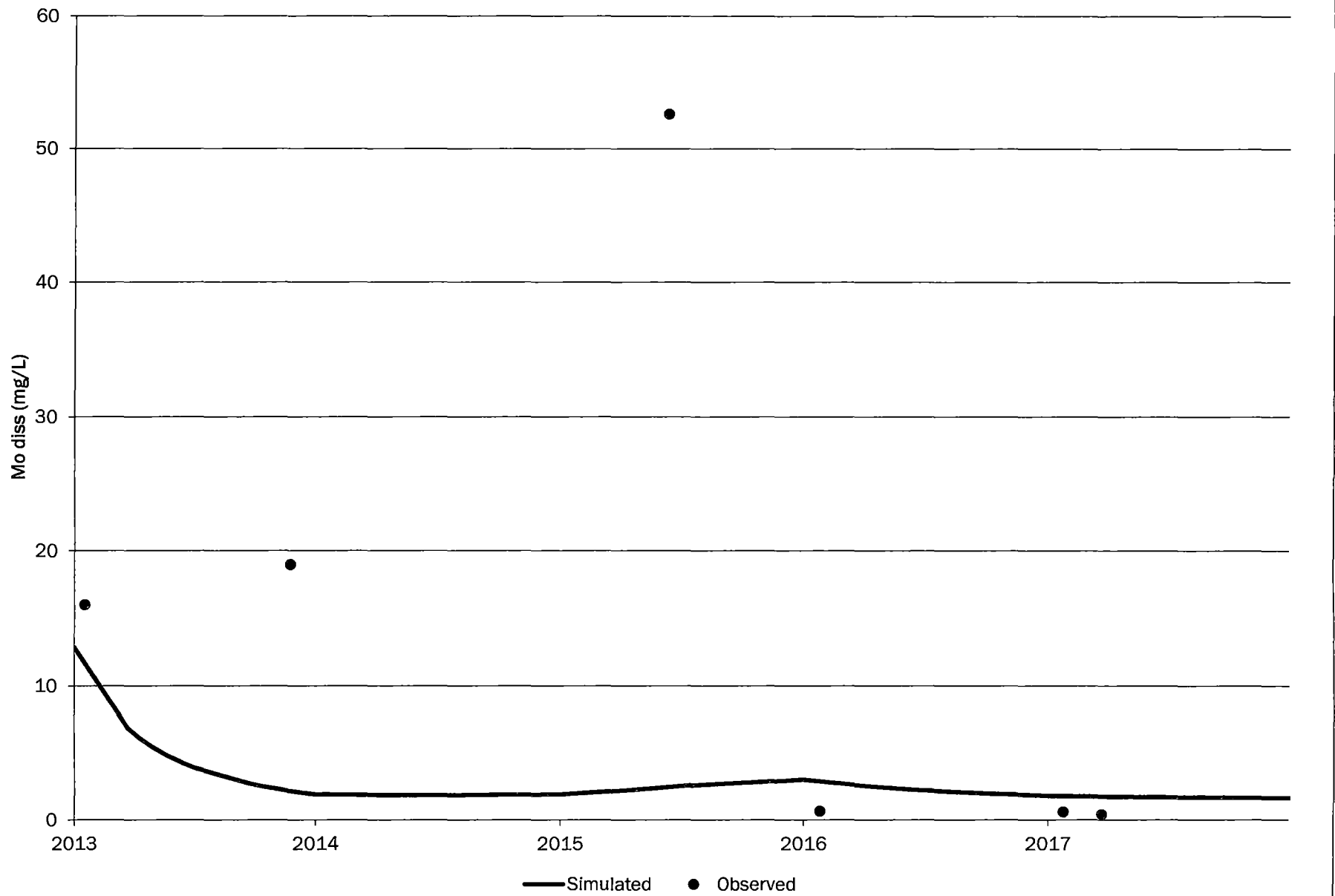
SQ-AI



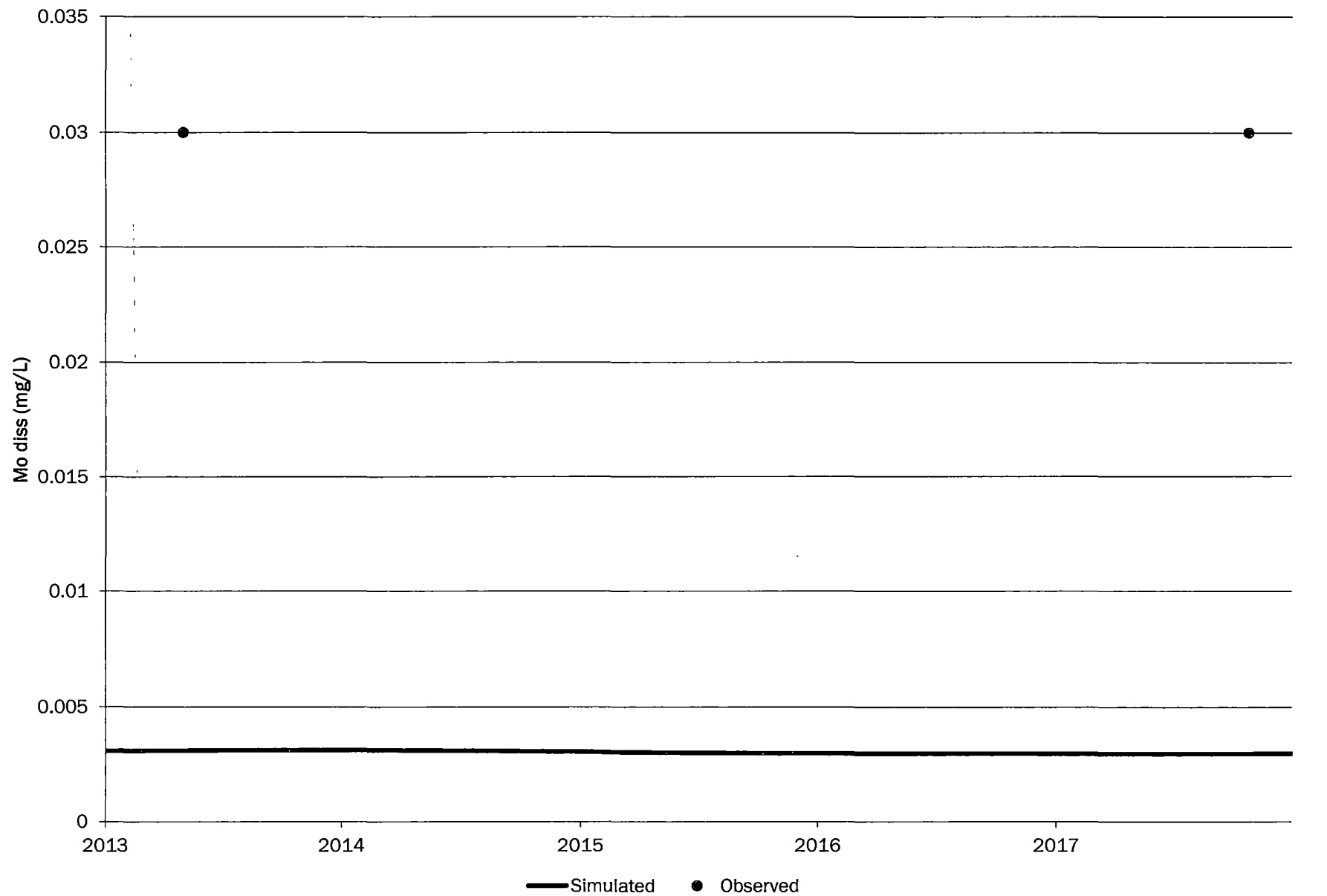
SS-AI



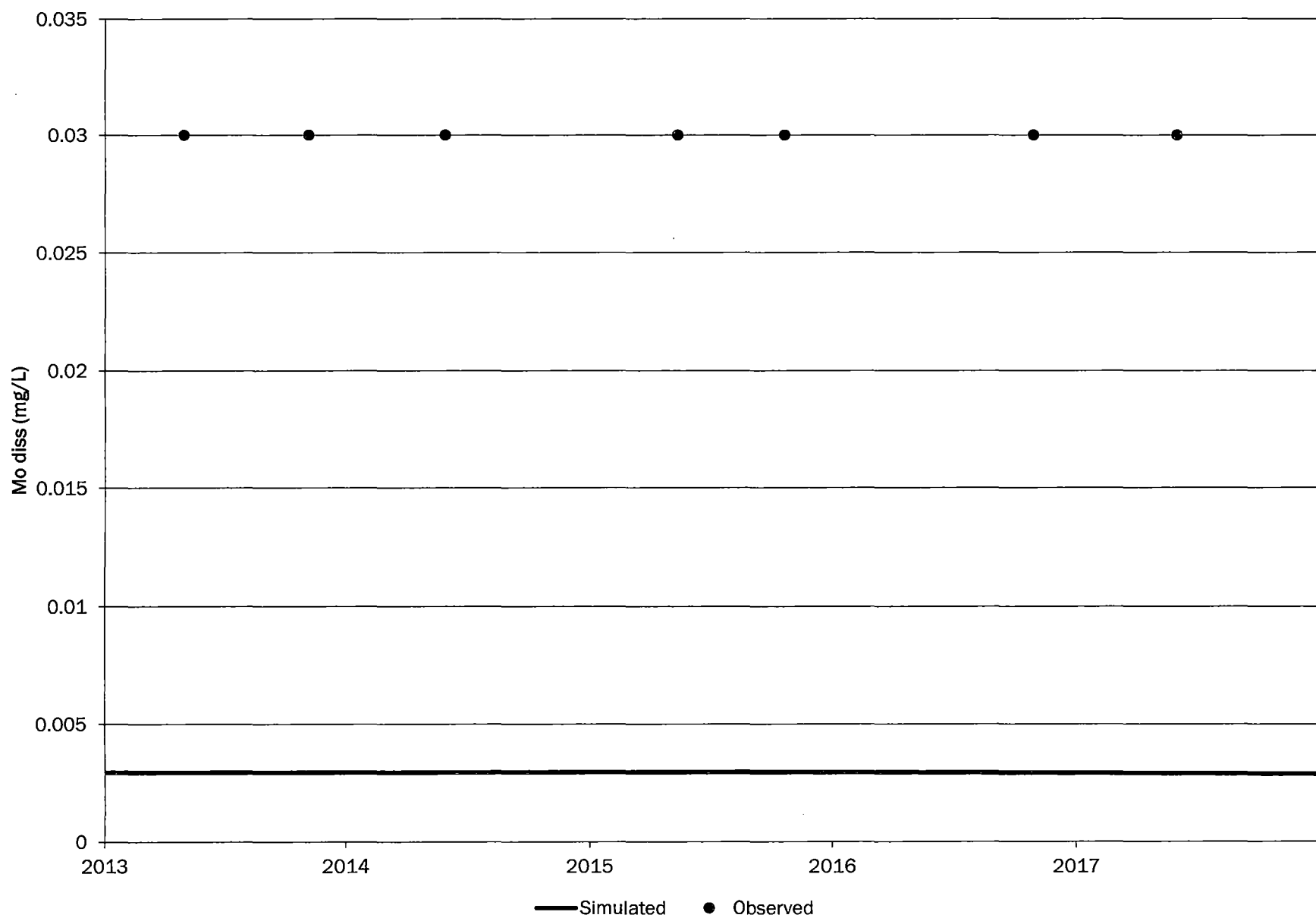
ST-AI



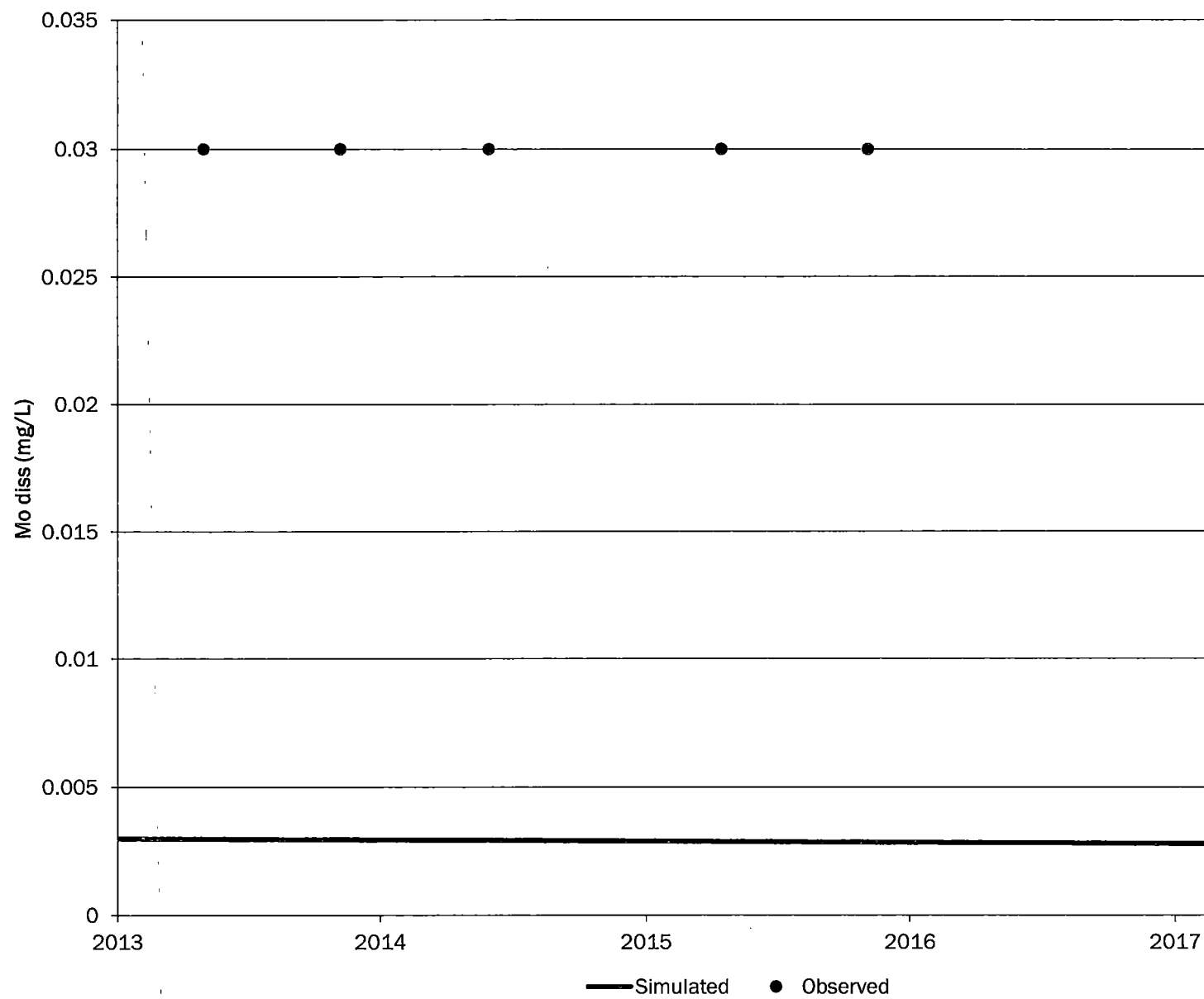
SUB1-AI



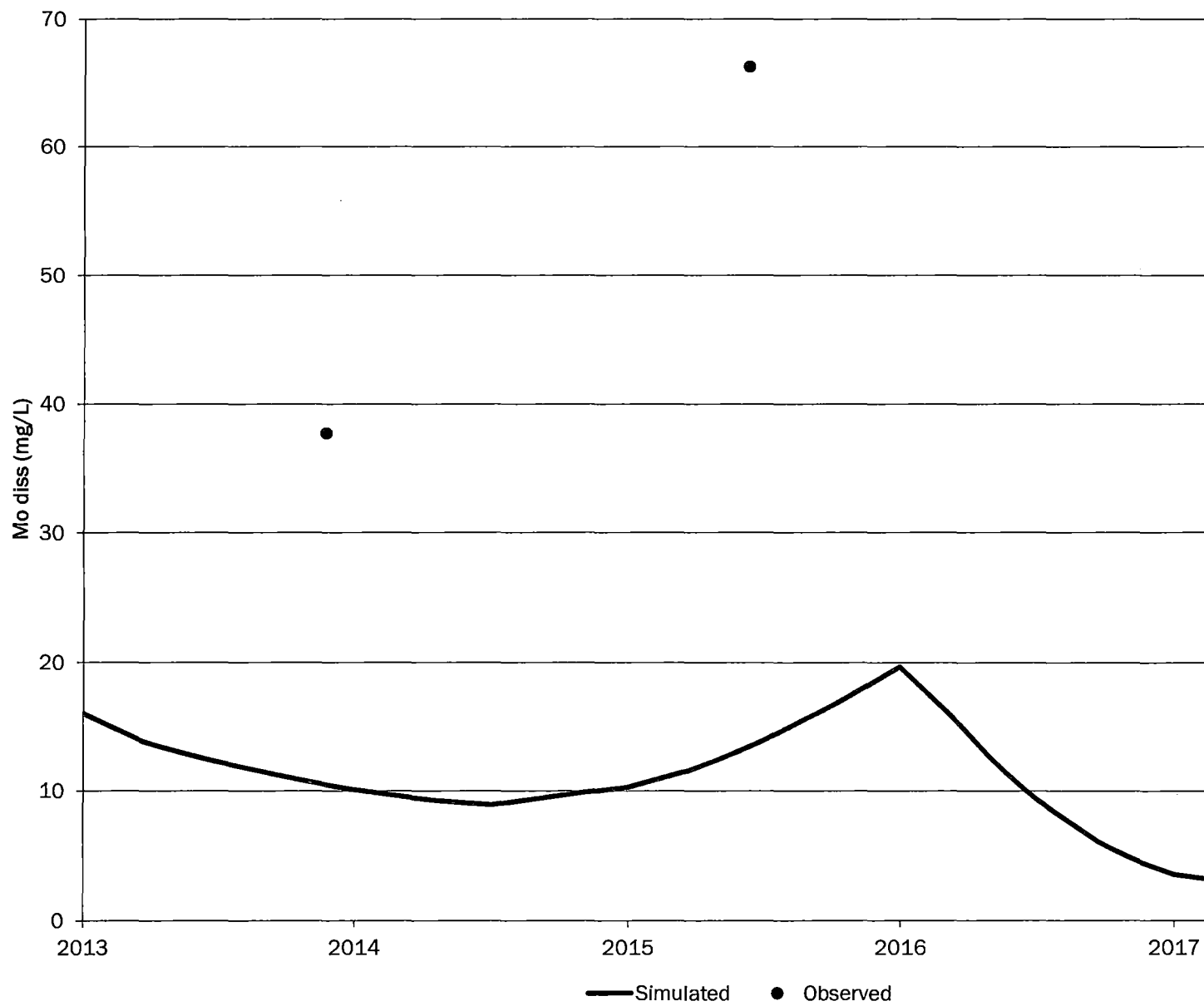
SUB2-AI



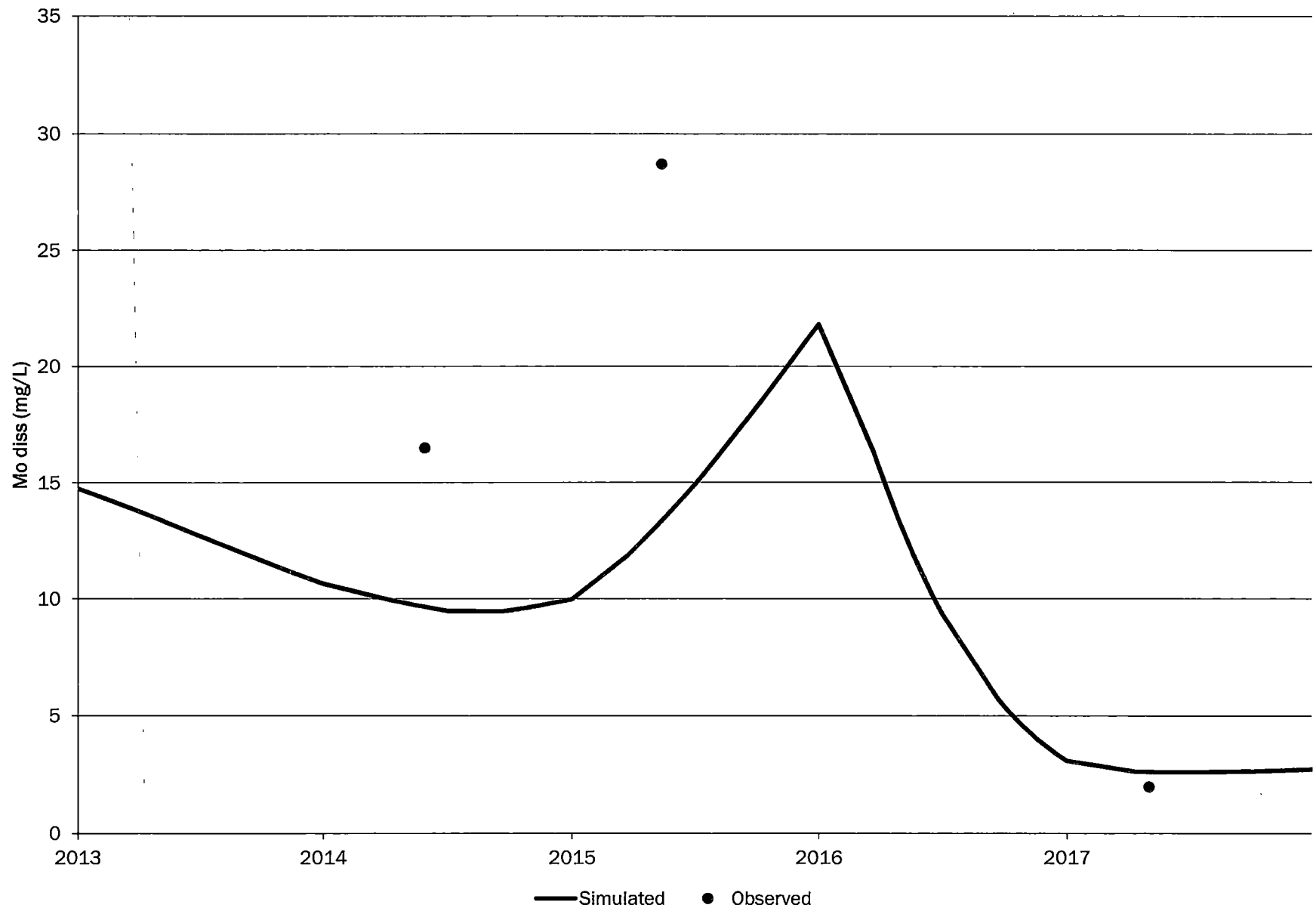
SUB3-AI



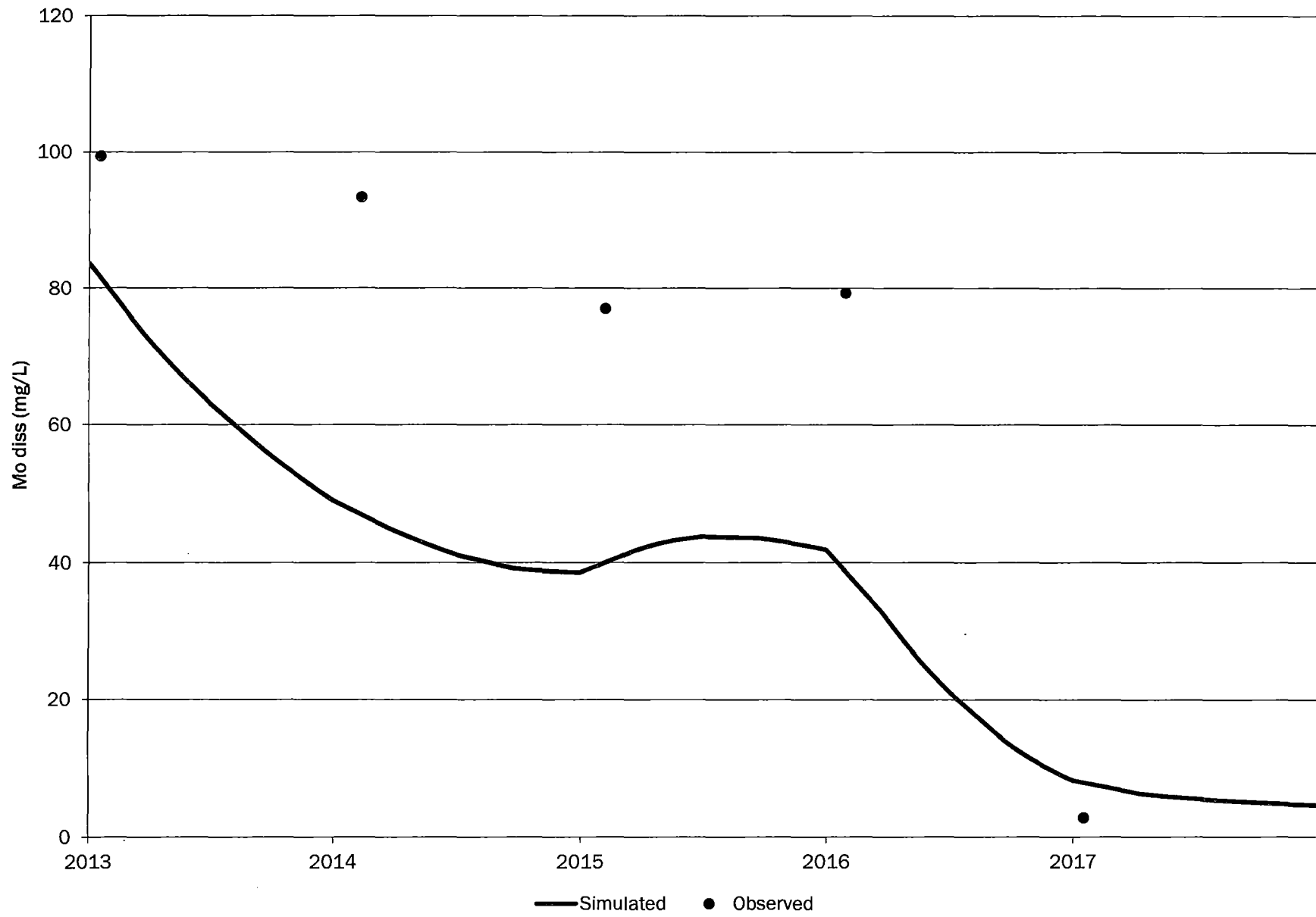
SV-AI



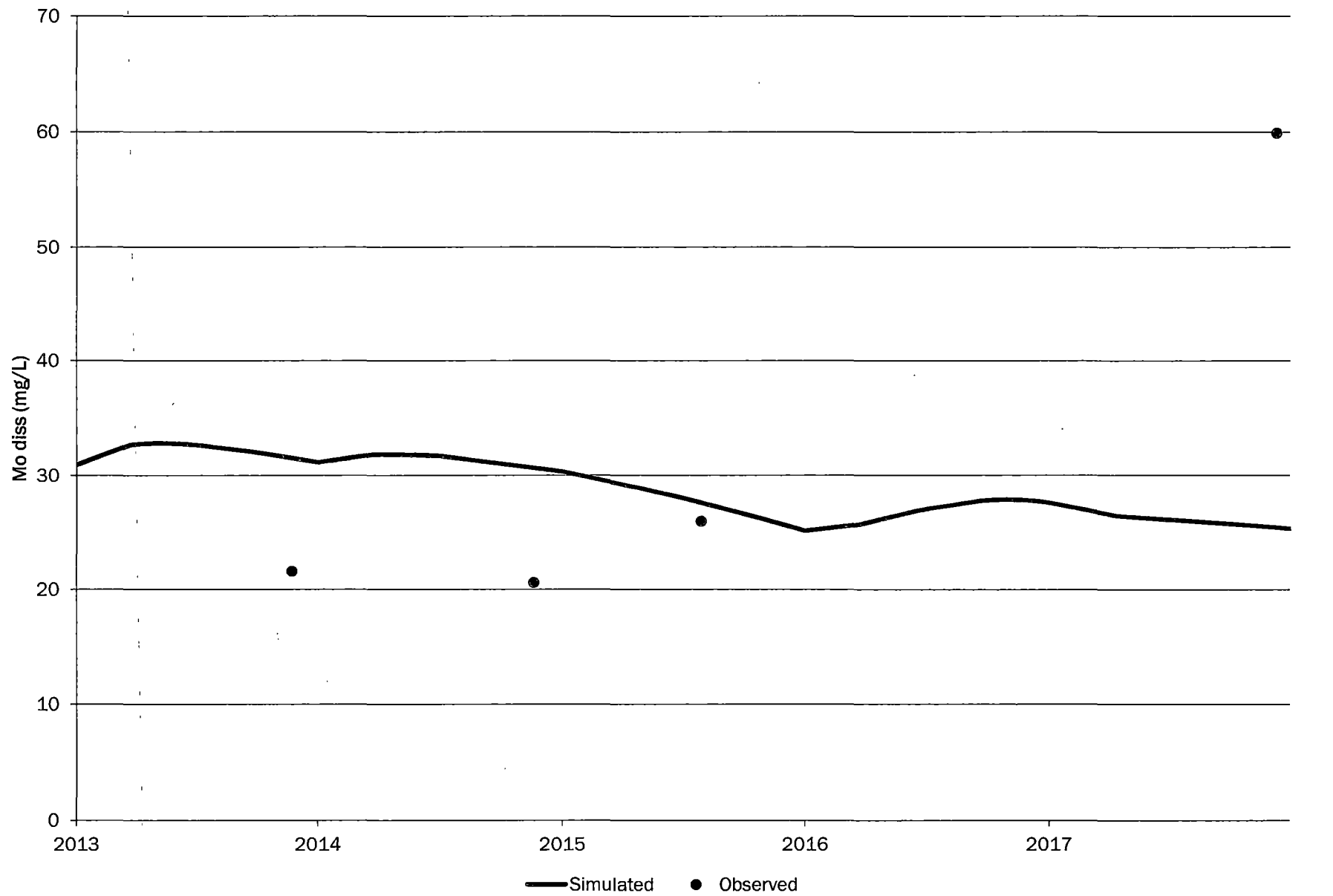
SW-AI



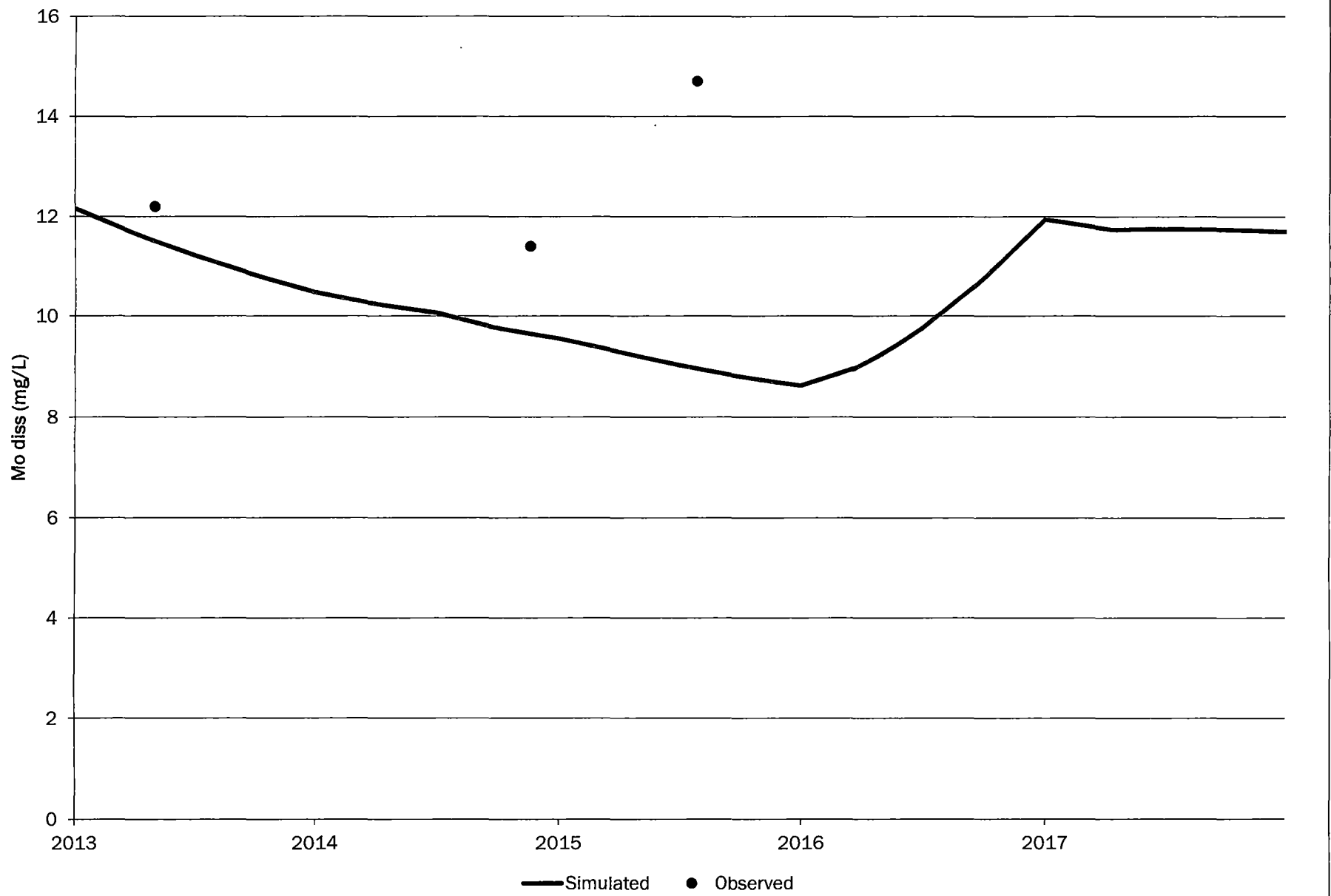
SZ-AI



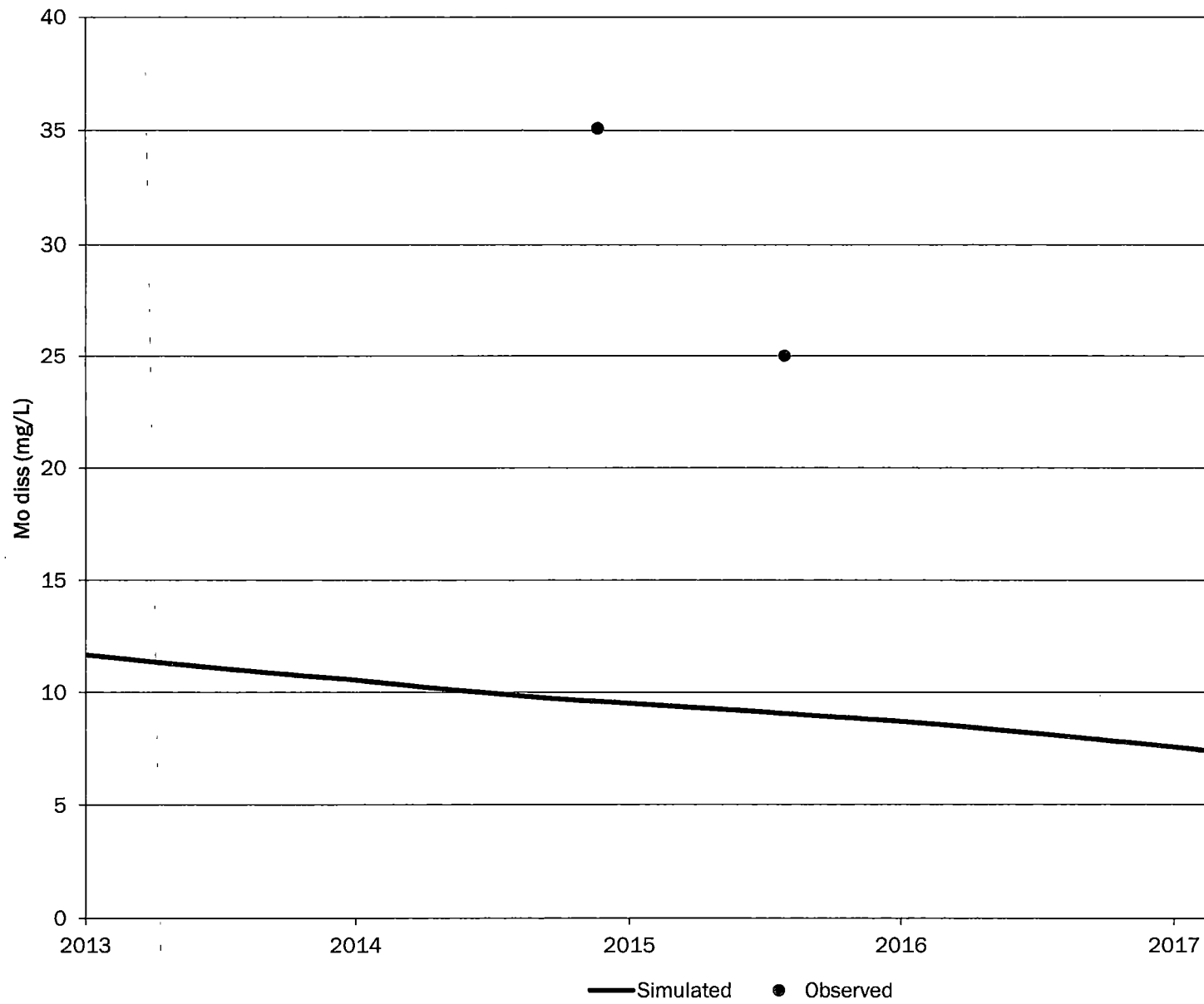
T2-AI



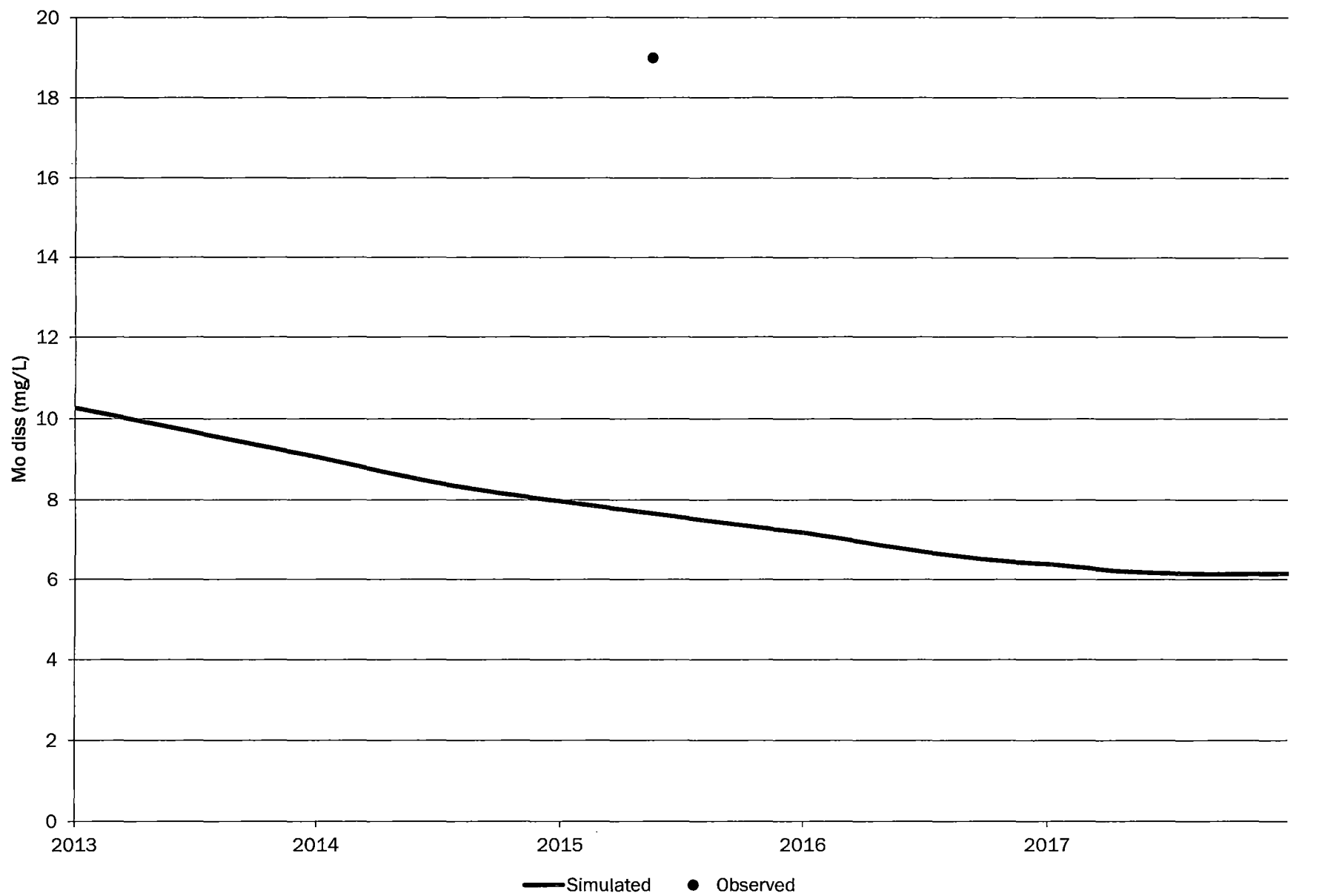
T4-AI



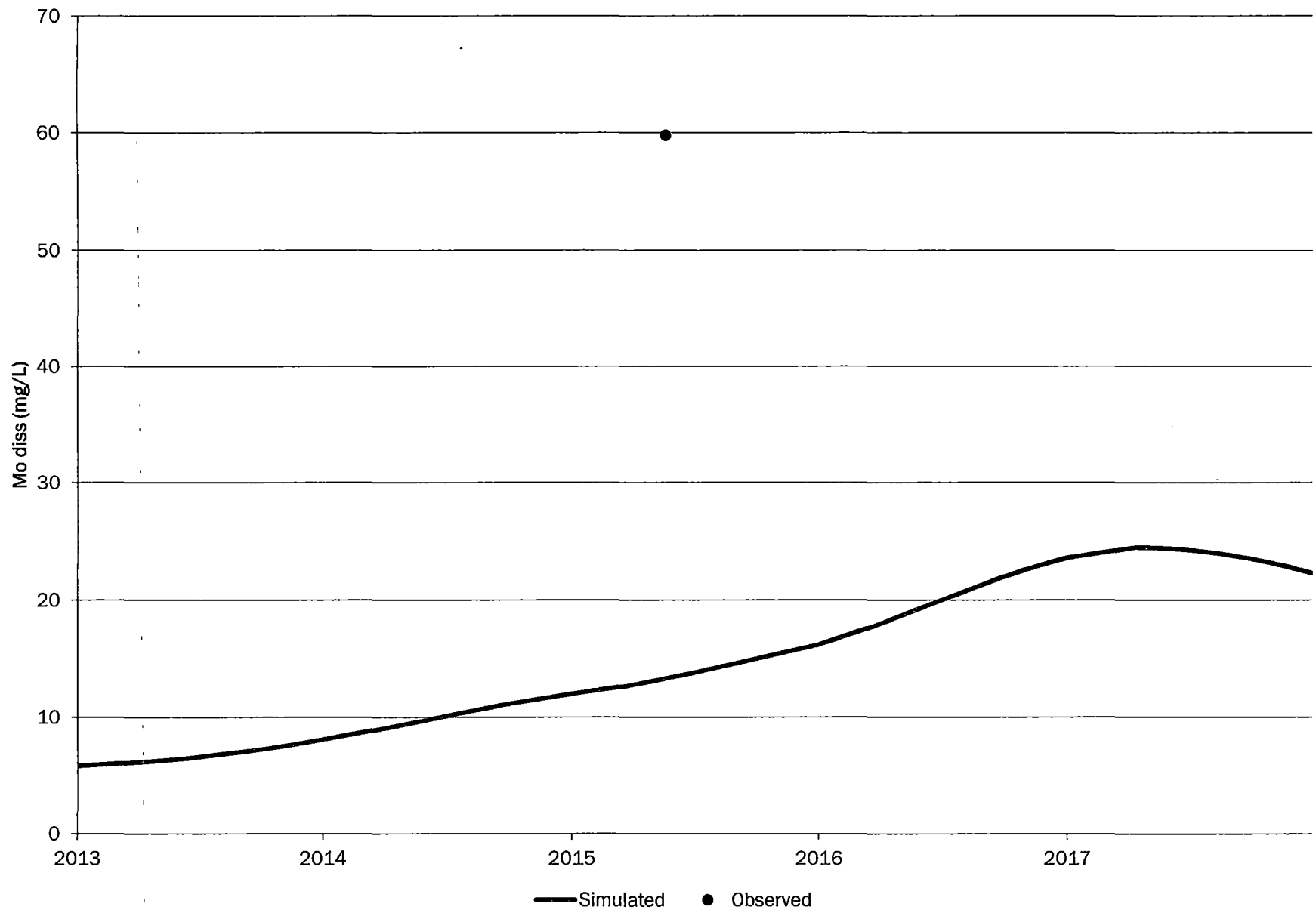
T5-AI



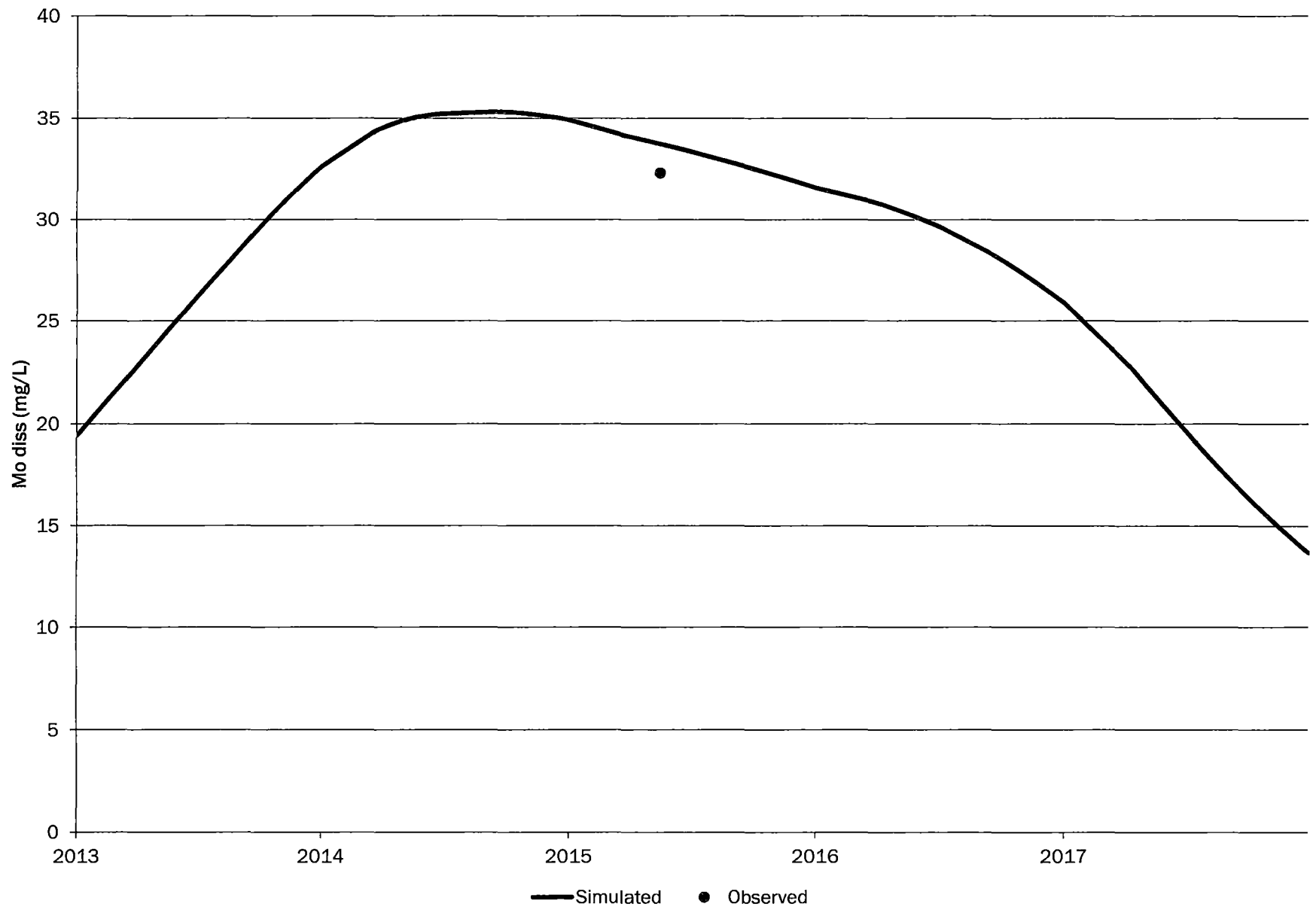
T6-AI



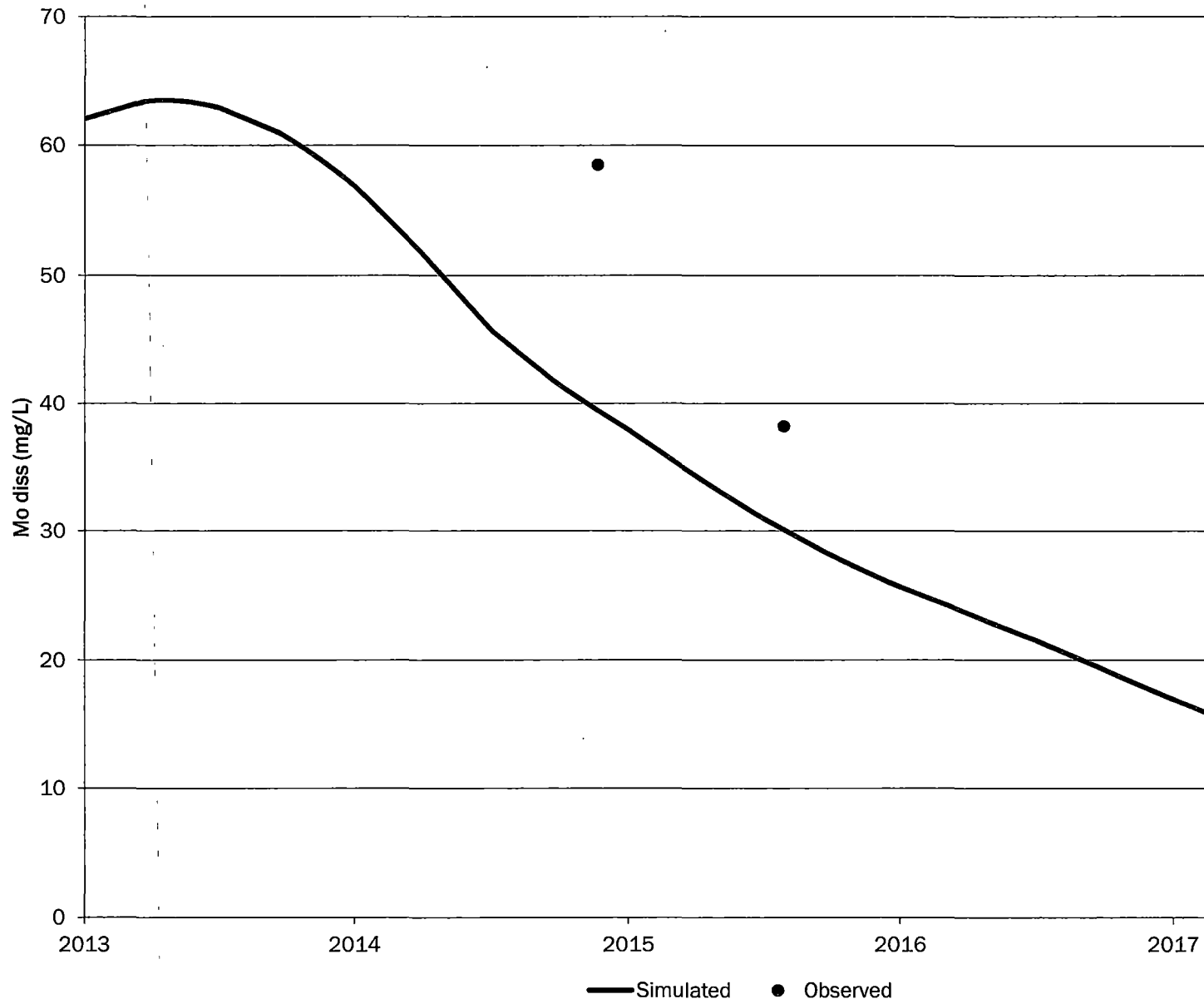
T7-AI



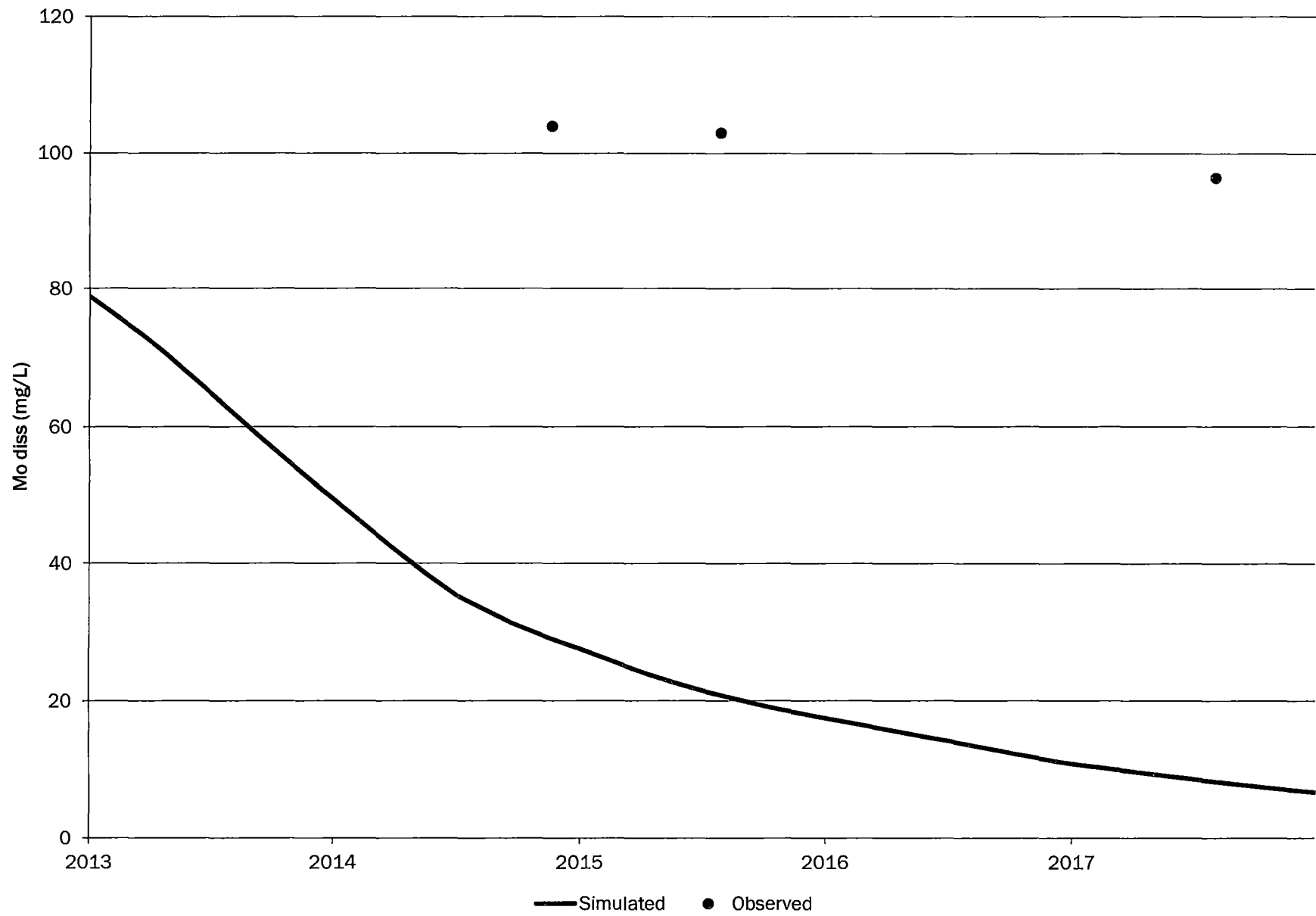
T8-AI



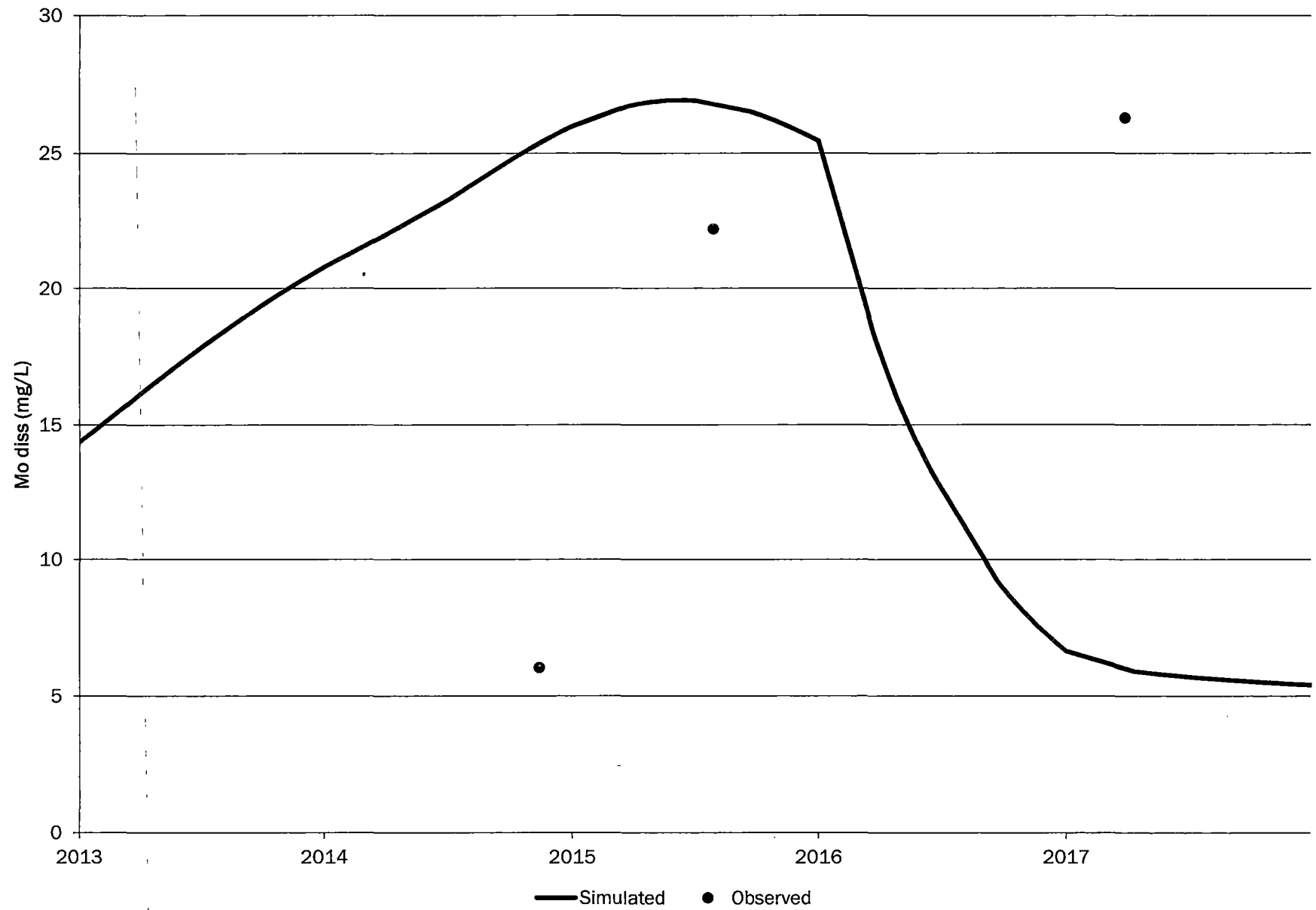
T9-AI



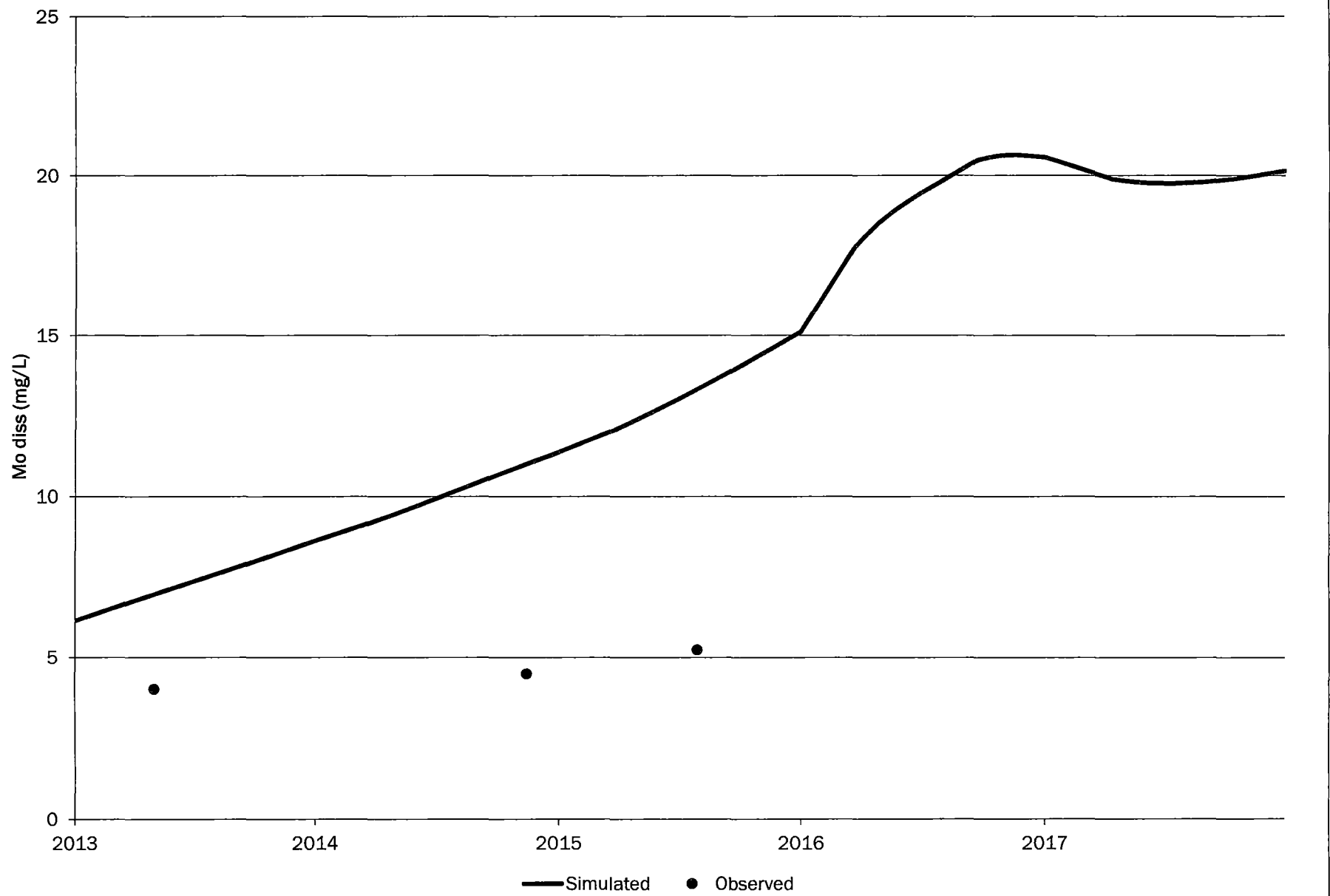
T10-AI



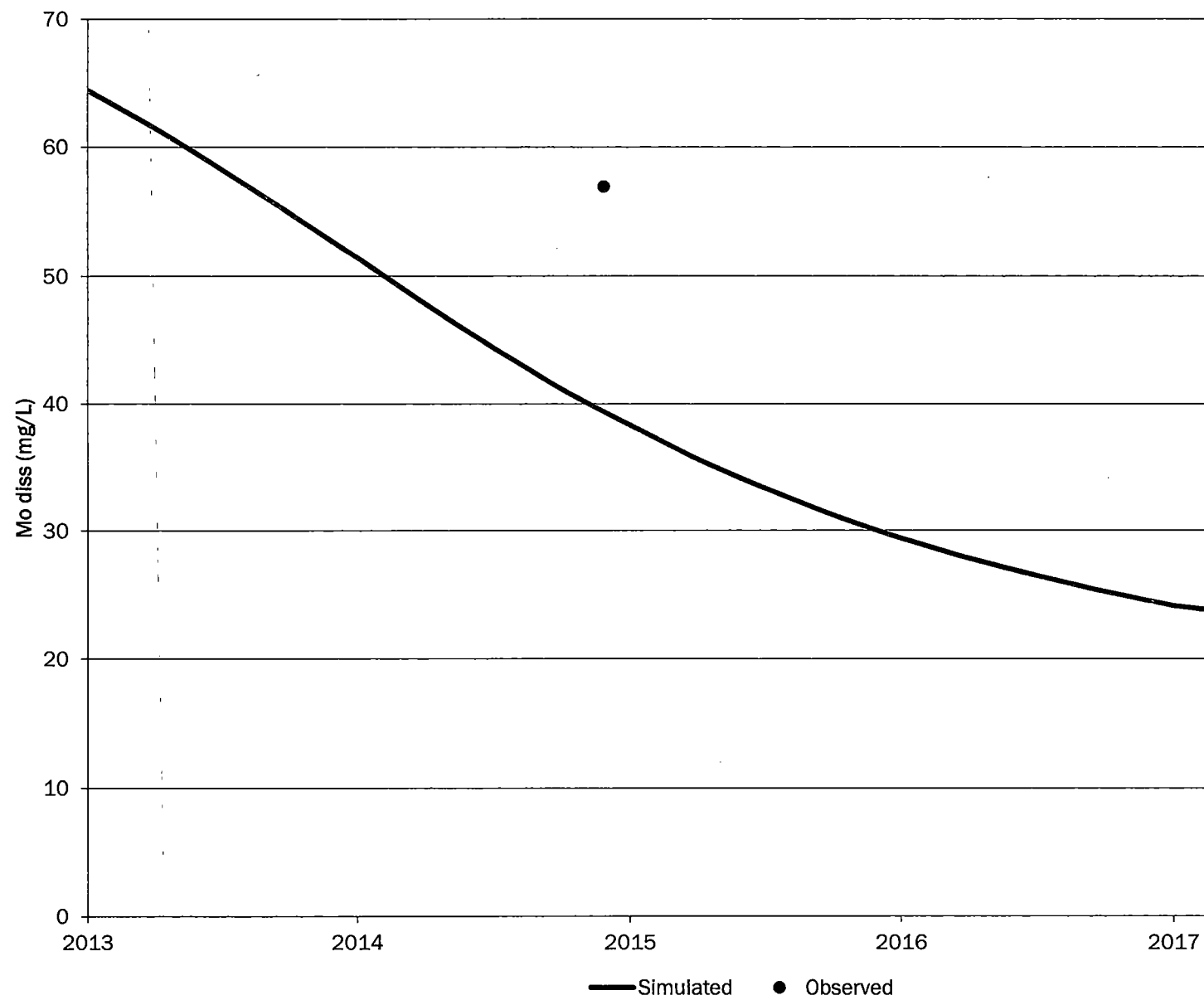
T11-AI



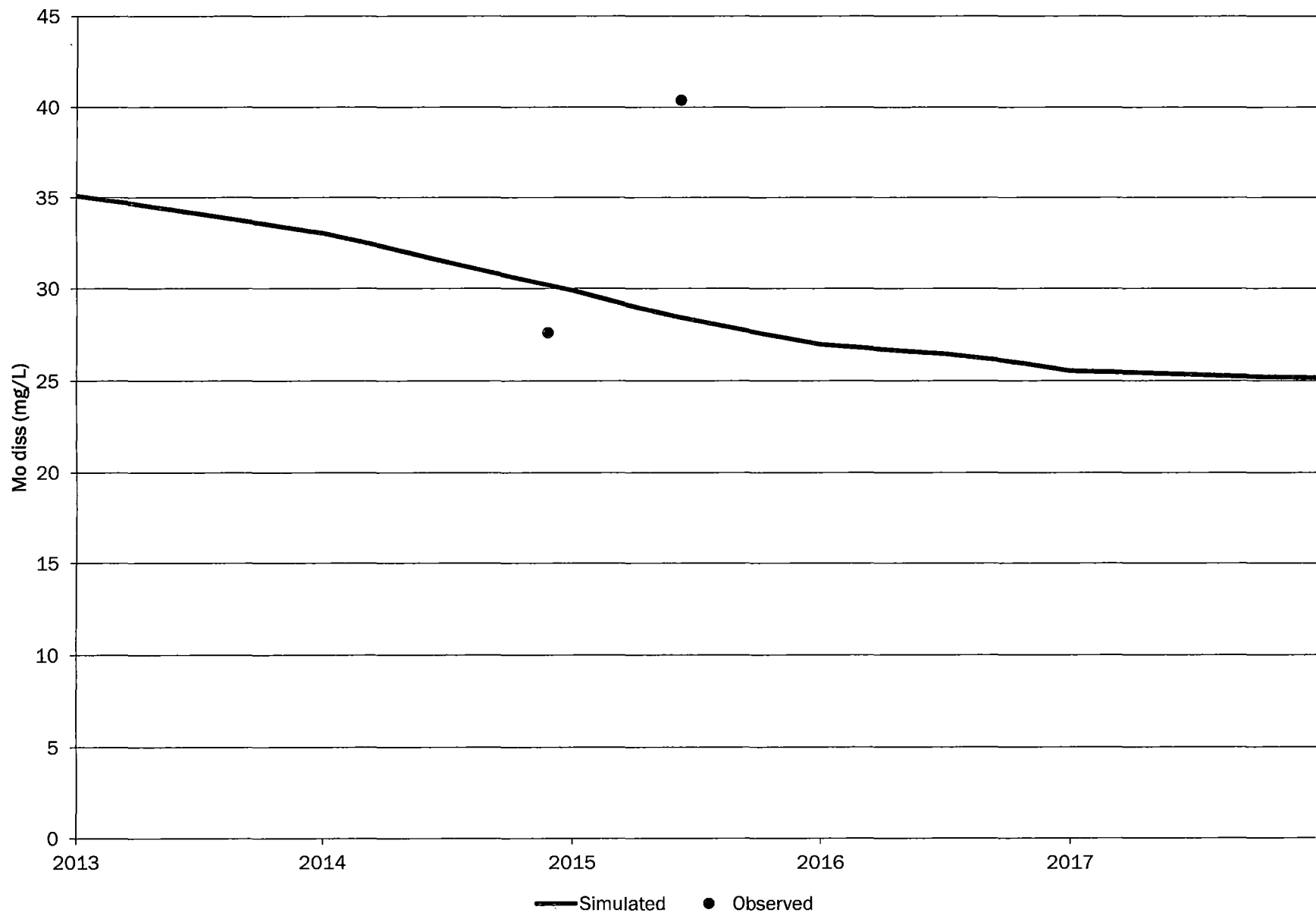
T12-AI



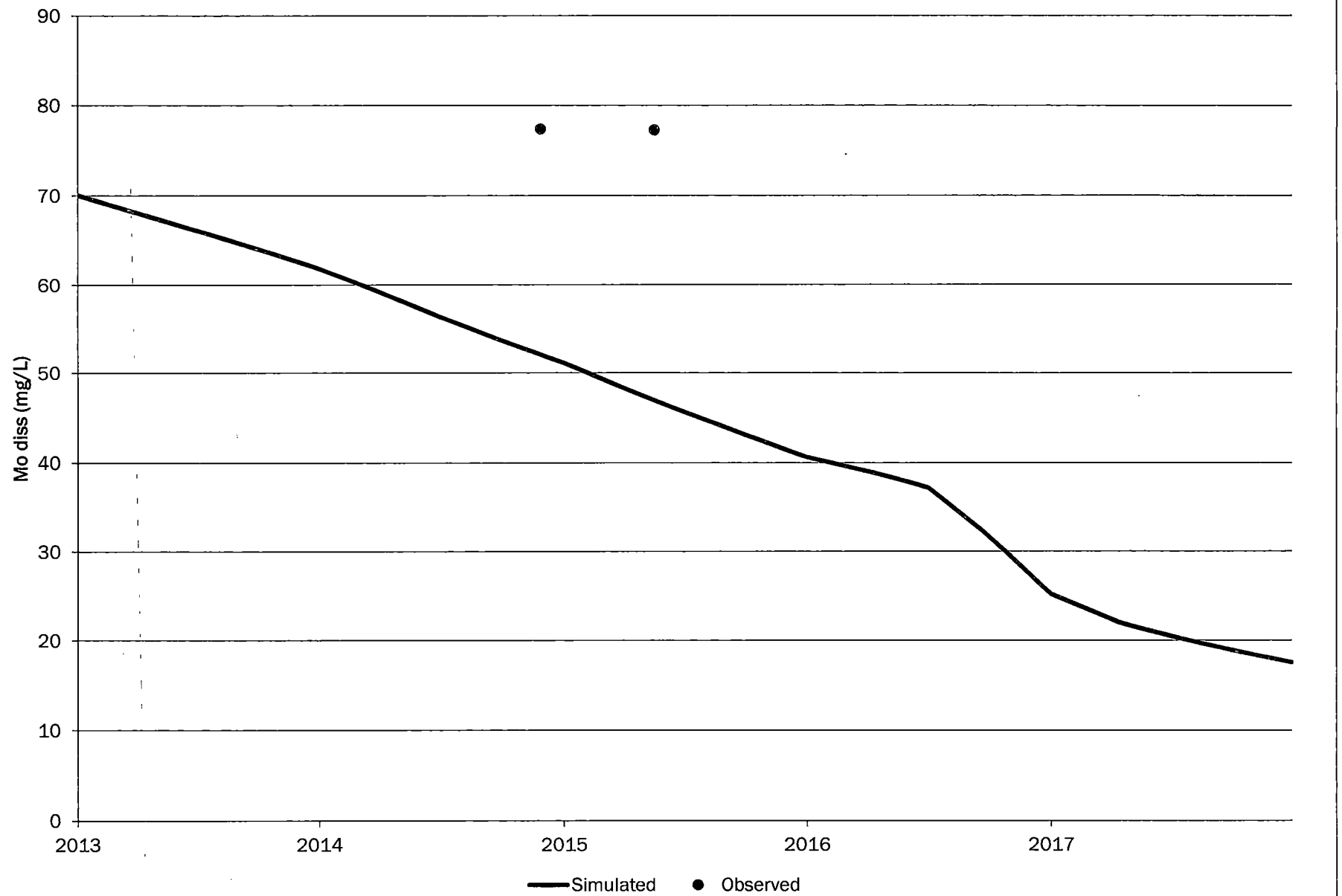
T14-AI



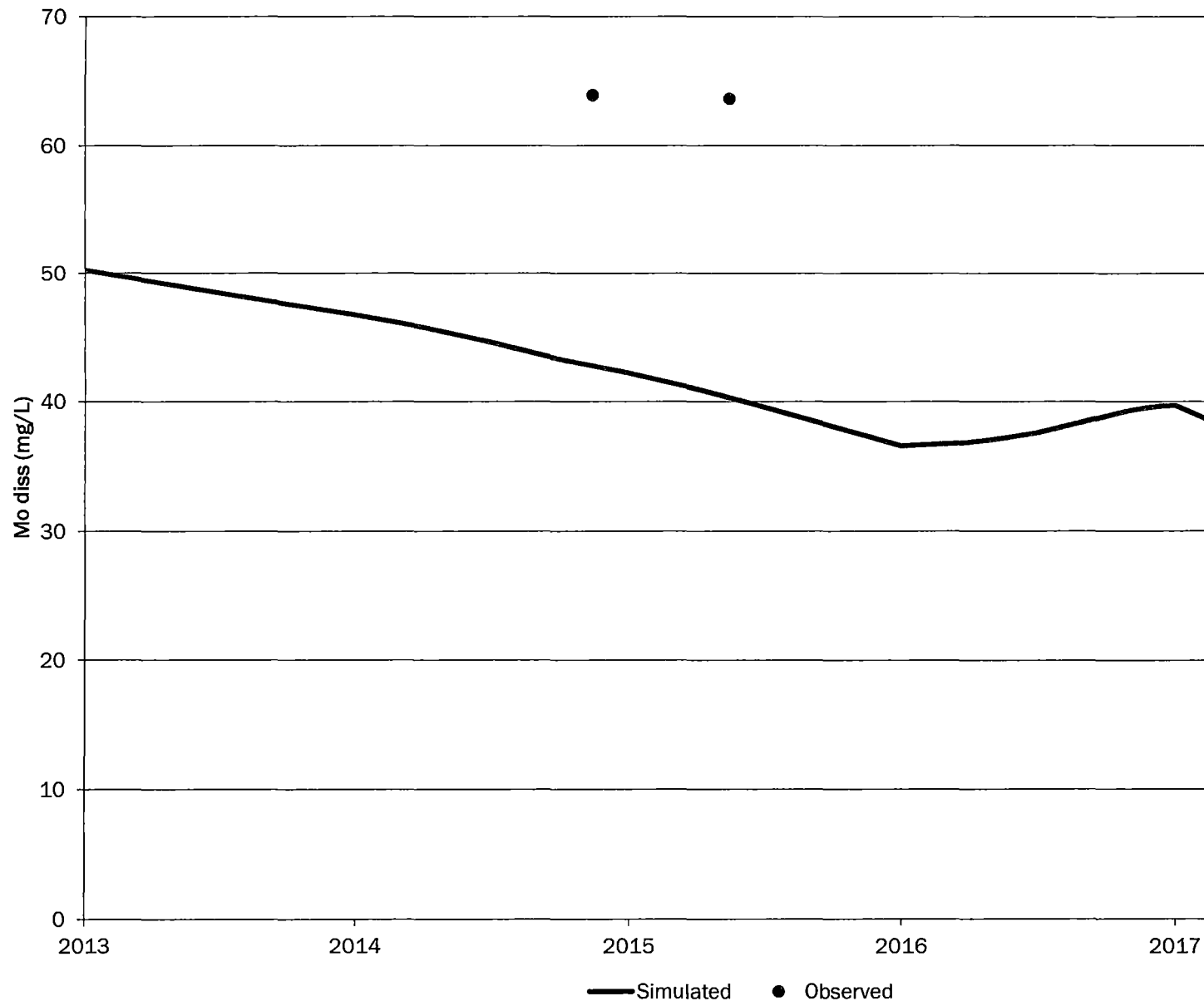
T15-AI



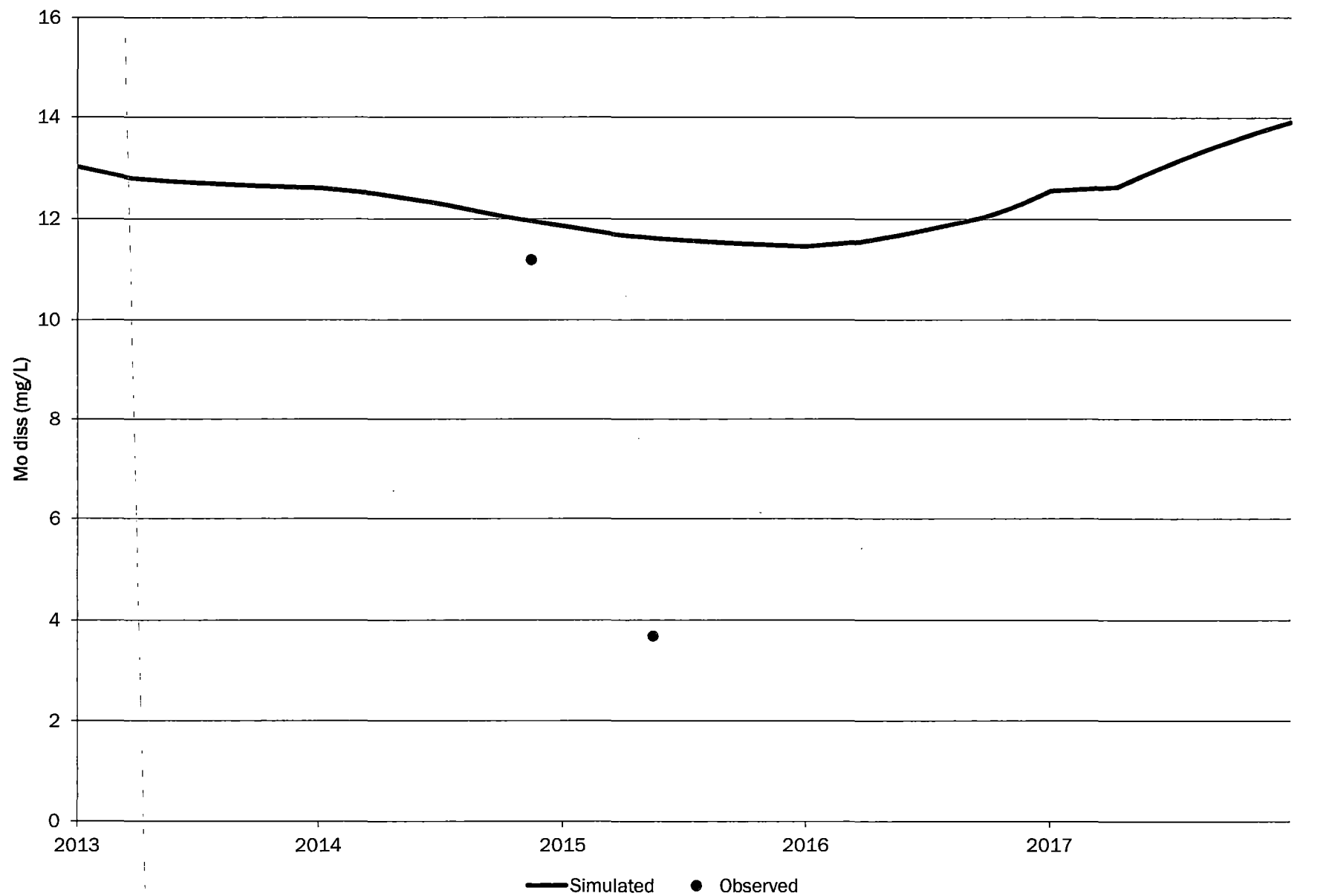
T16-AI



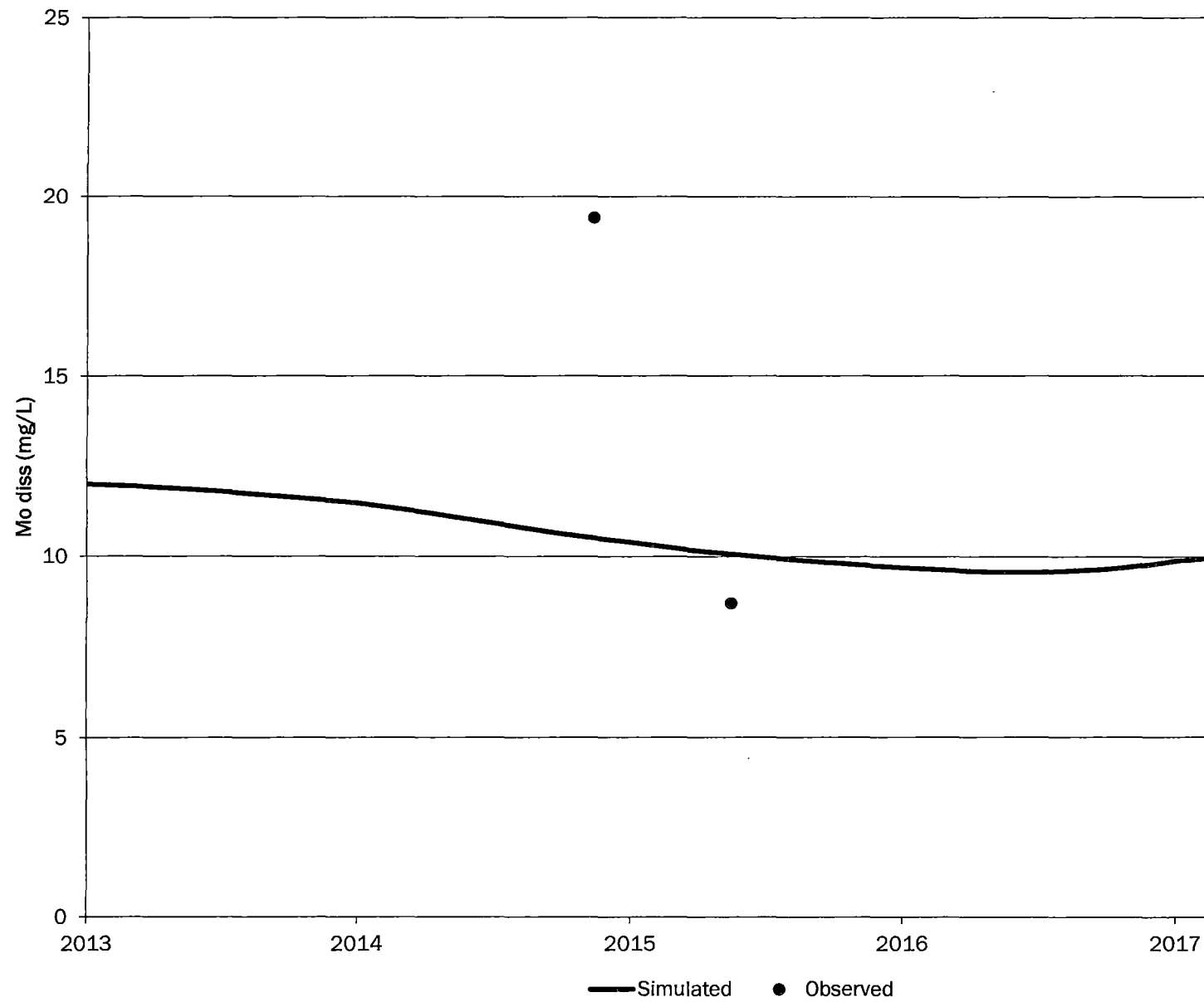
T17-AI



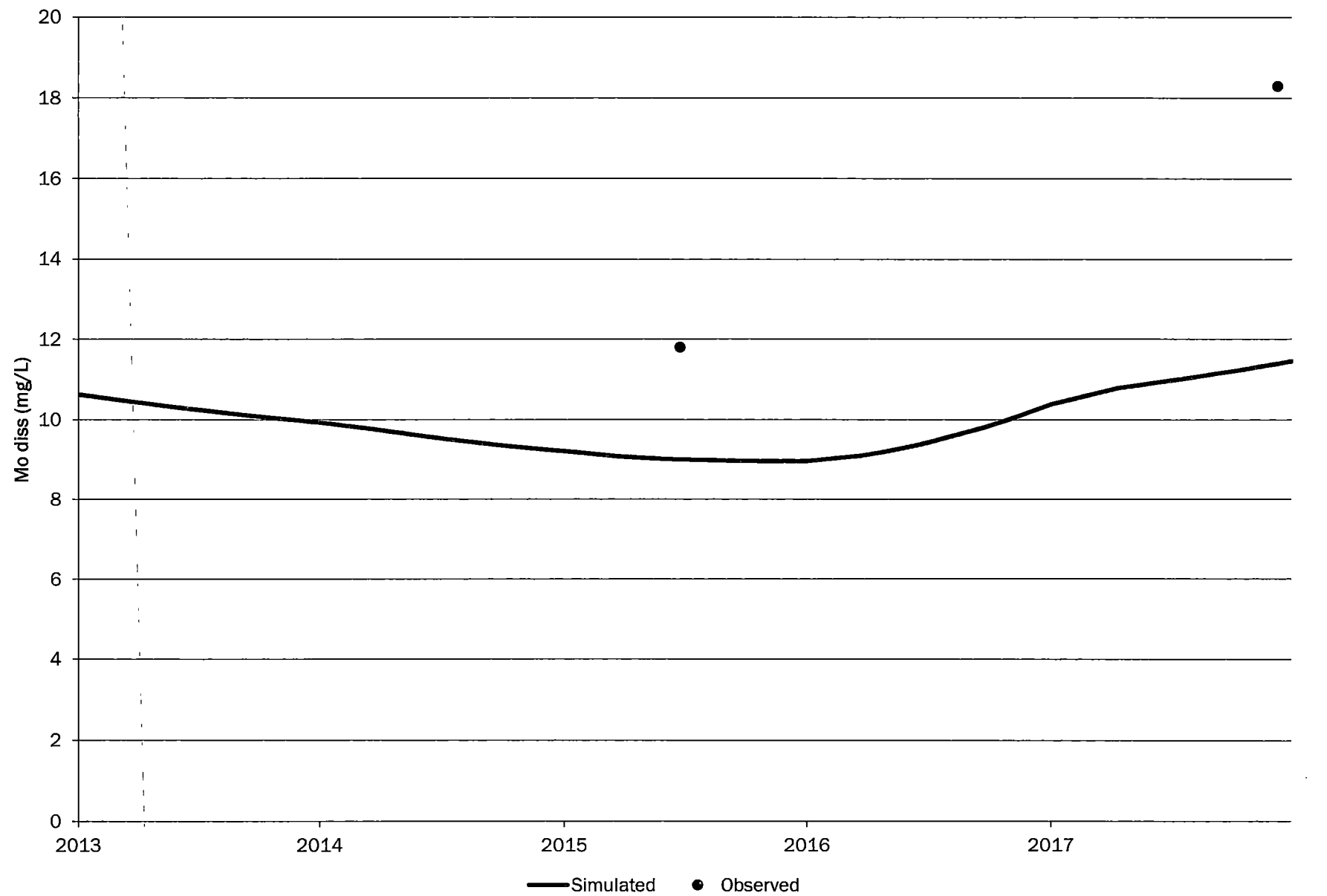
T18-AI



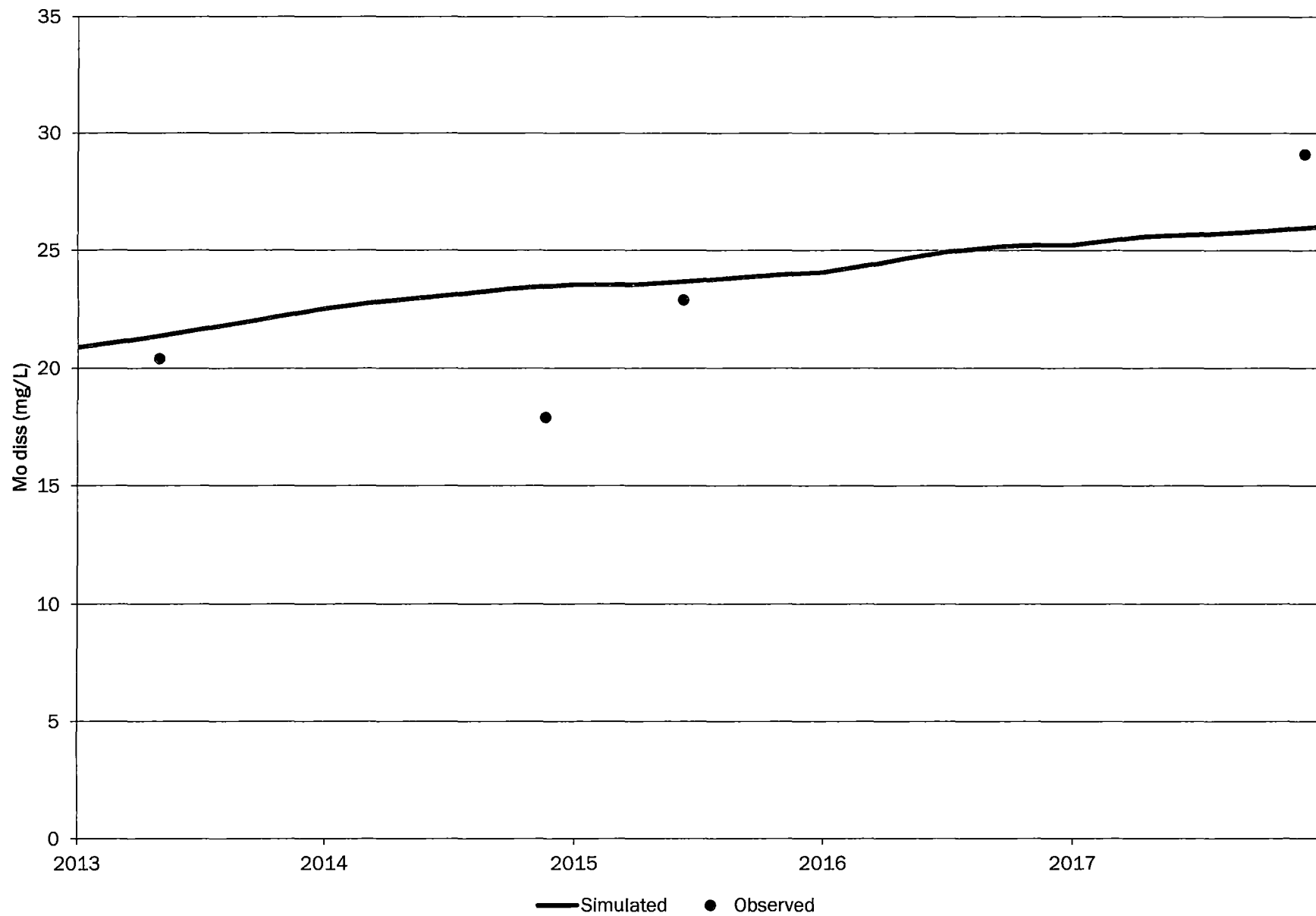
T19-AI



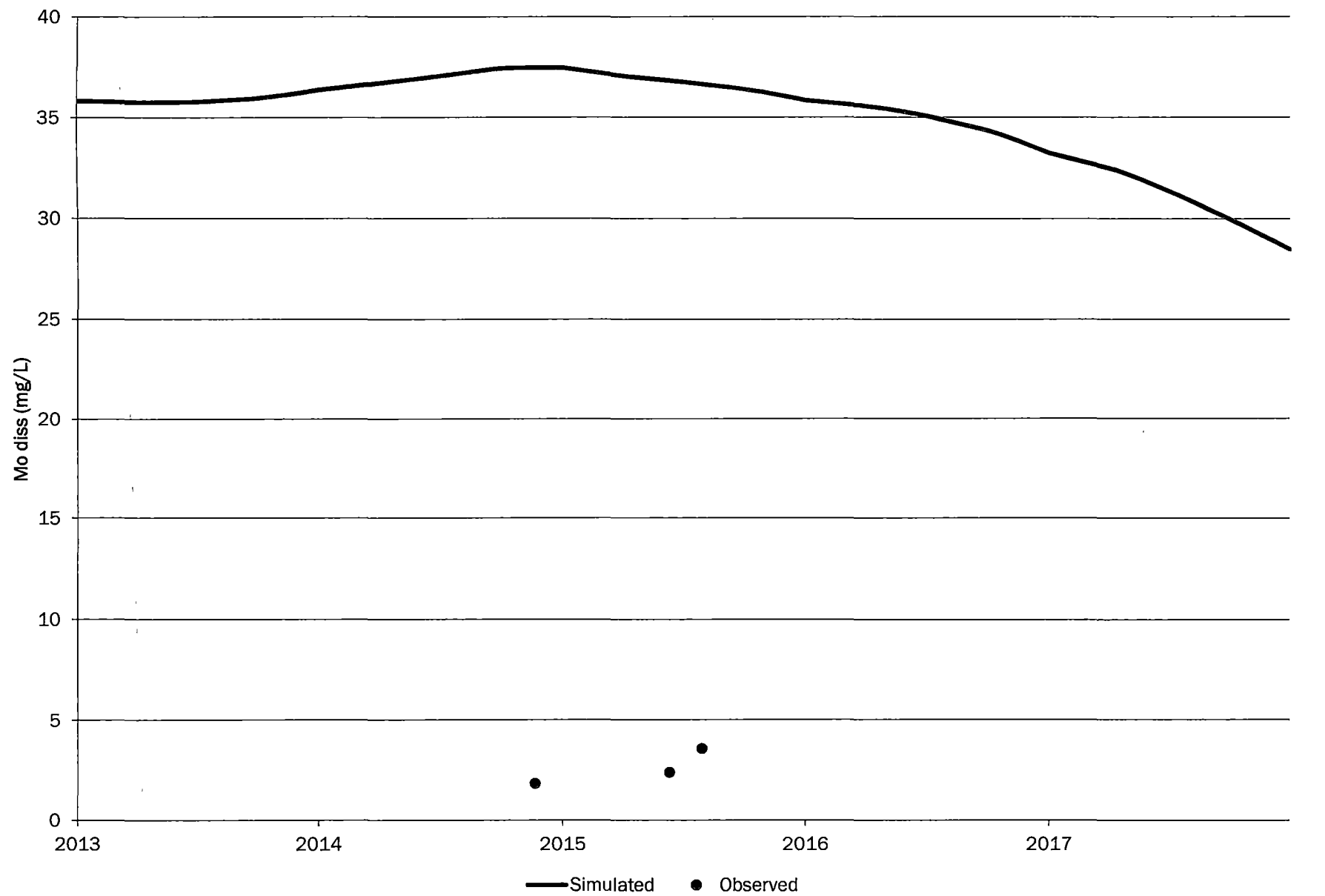
T20-AI



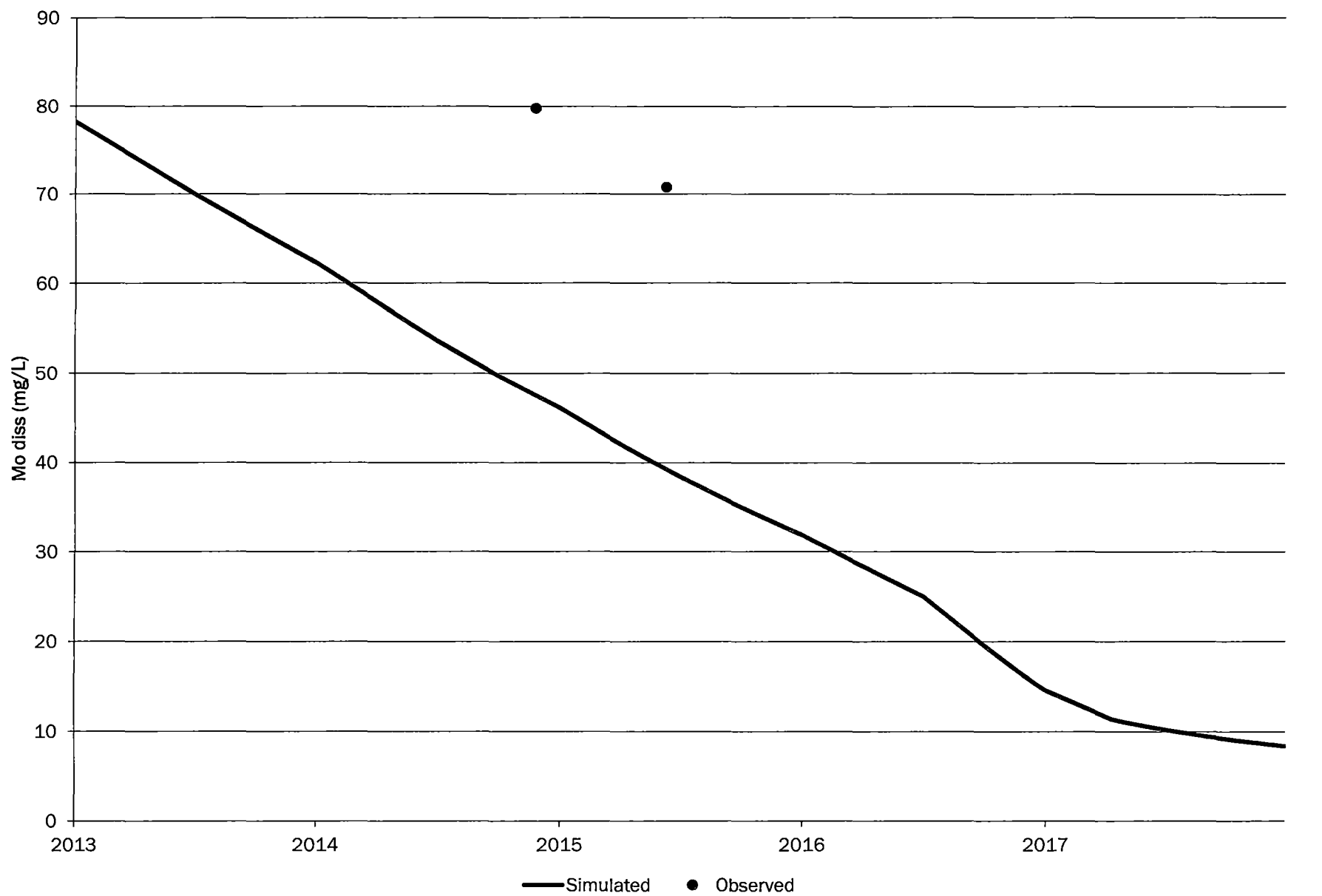
T21-AI



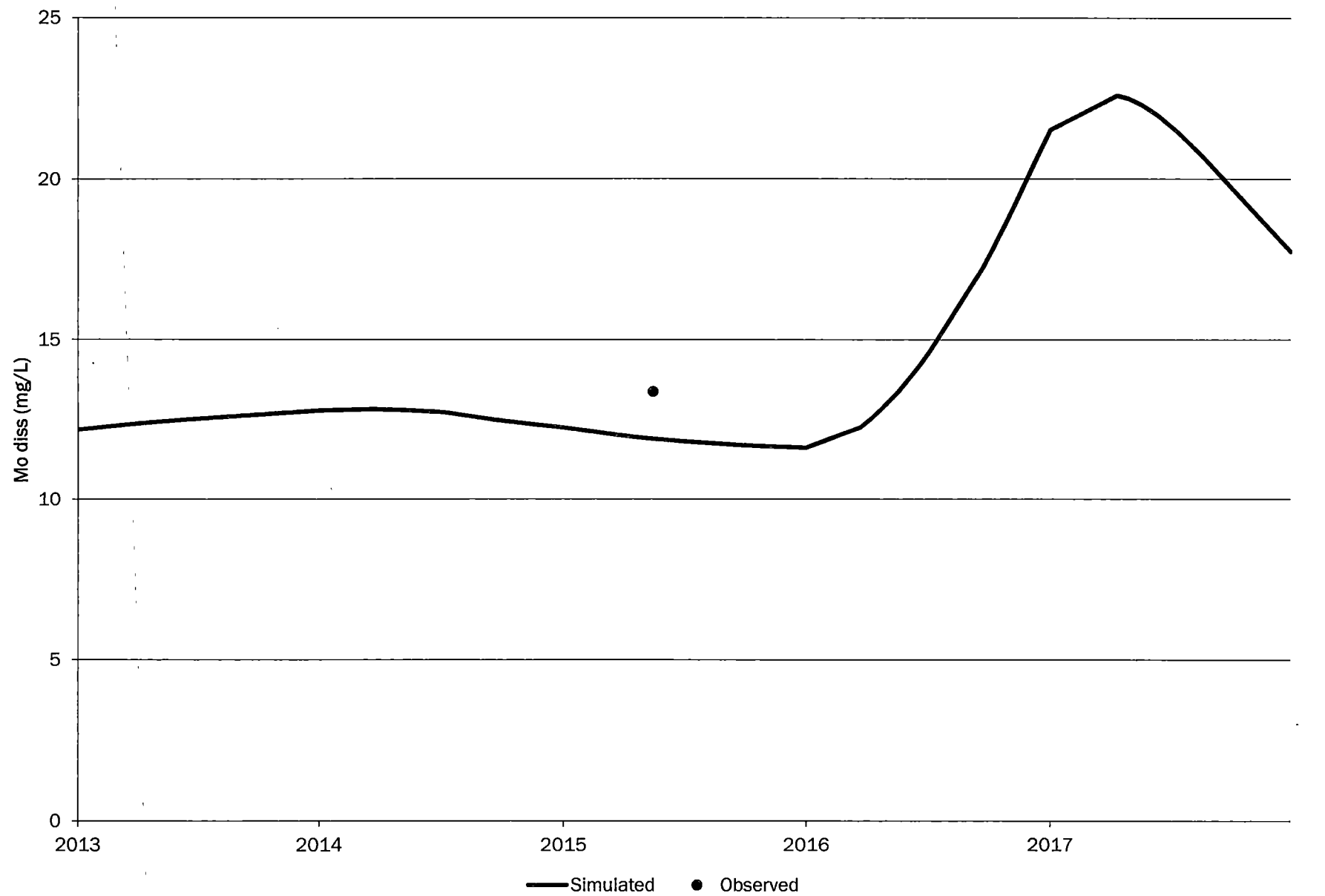
T22-AI



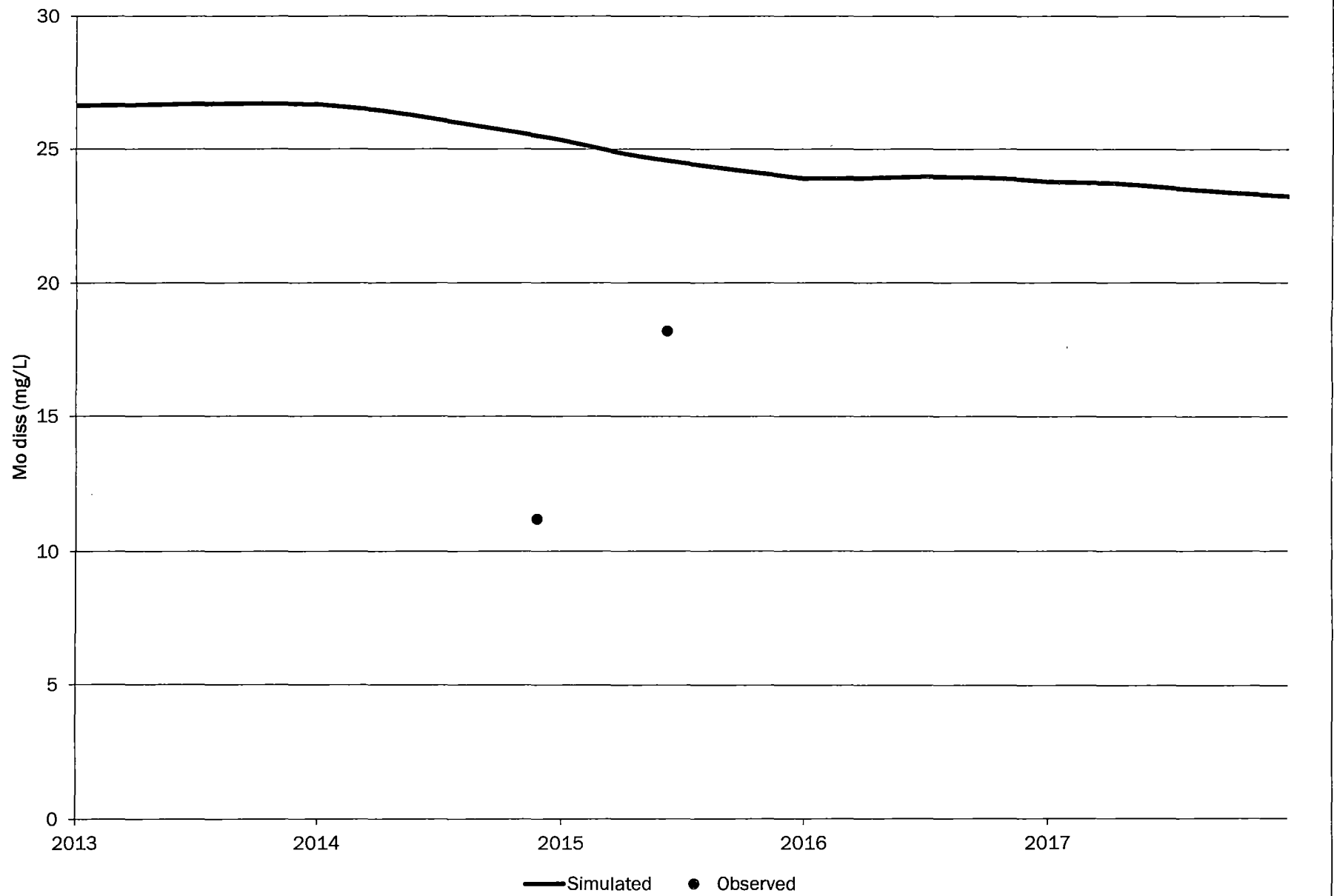
T23-AI



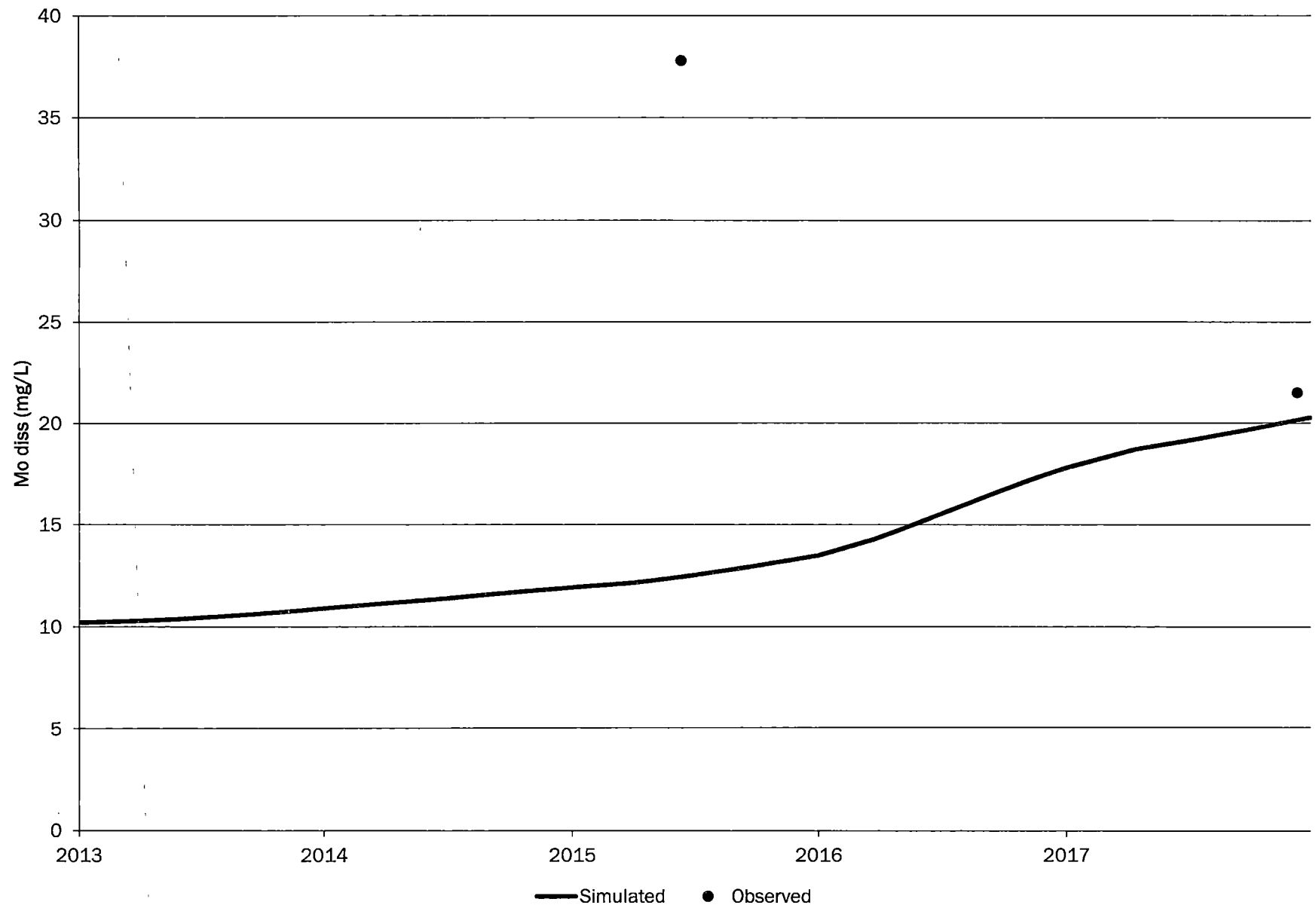
T36-AI



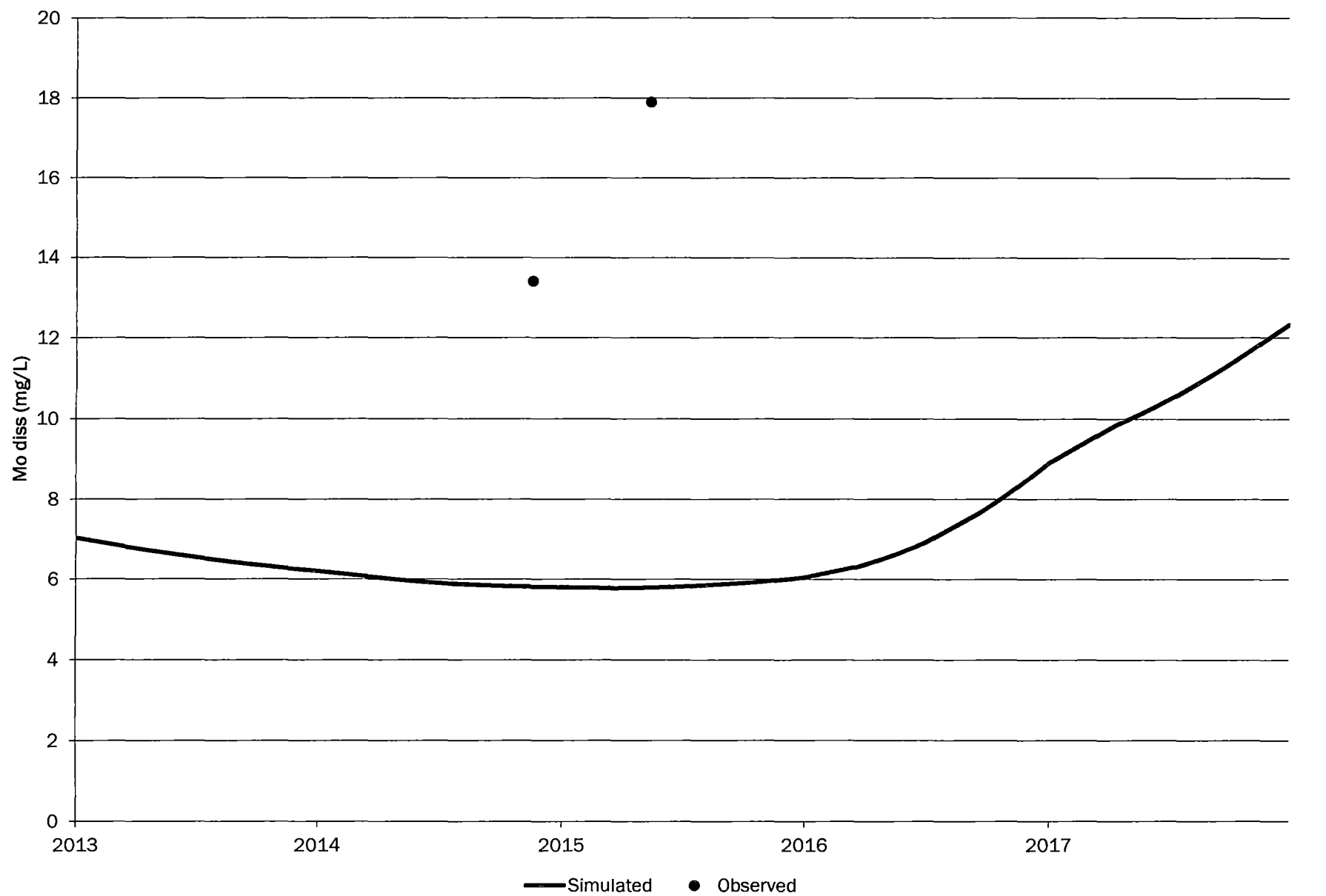
T39-AI



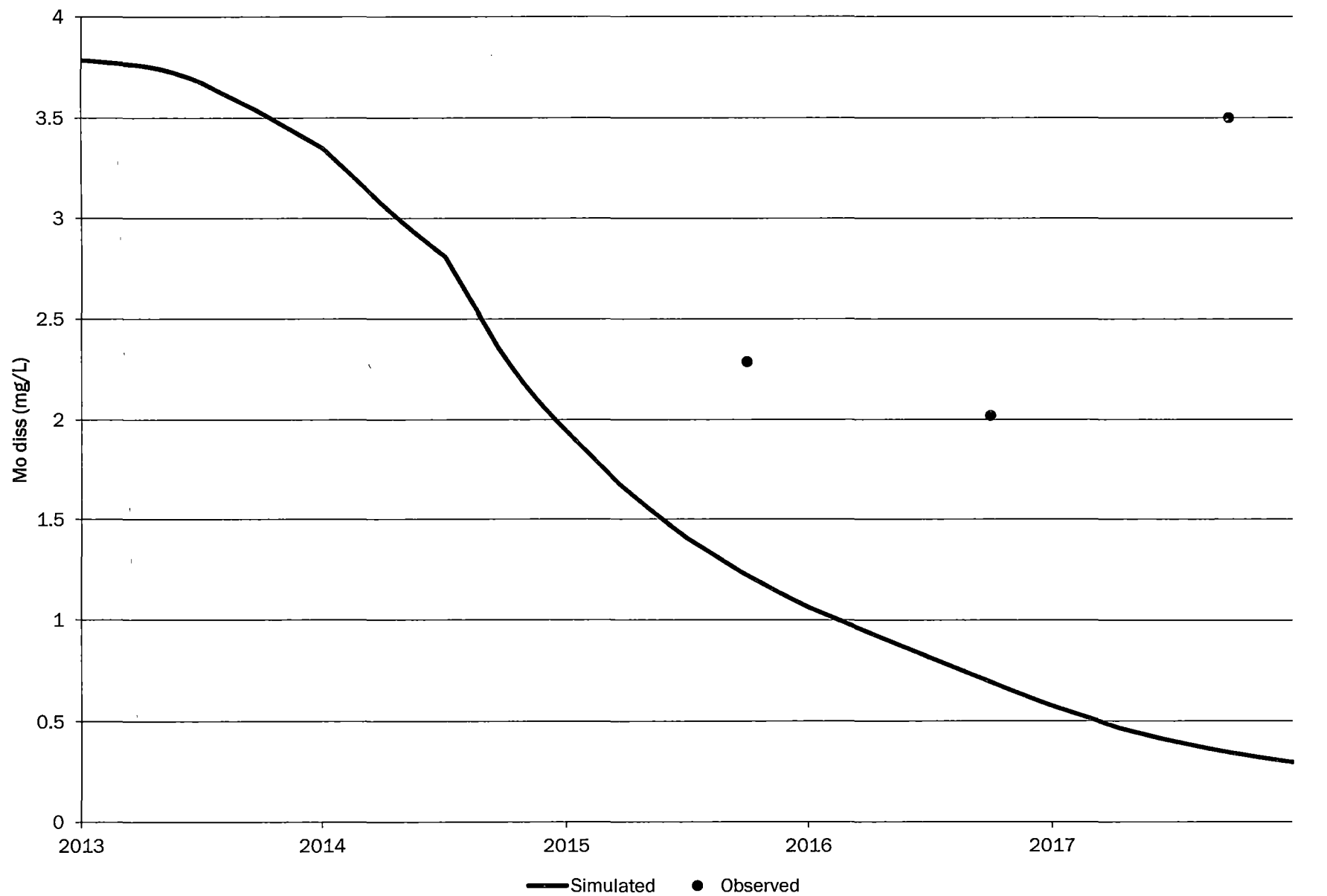
T40-AI



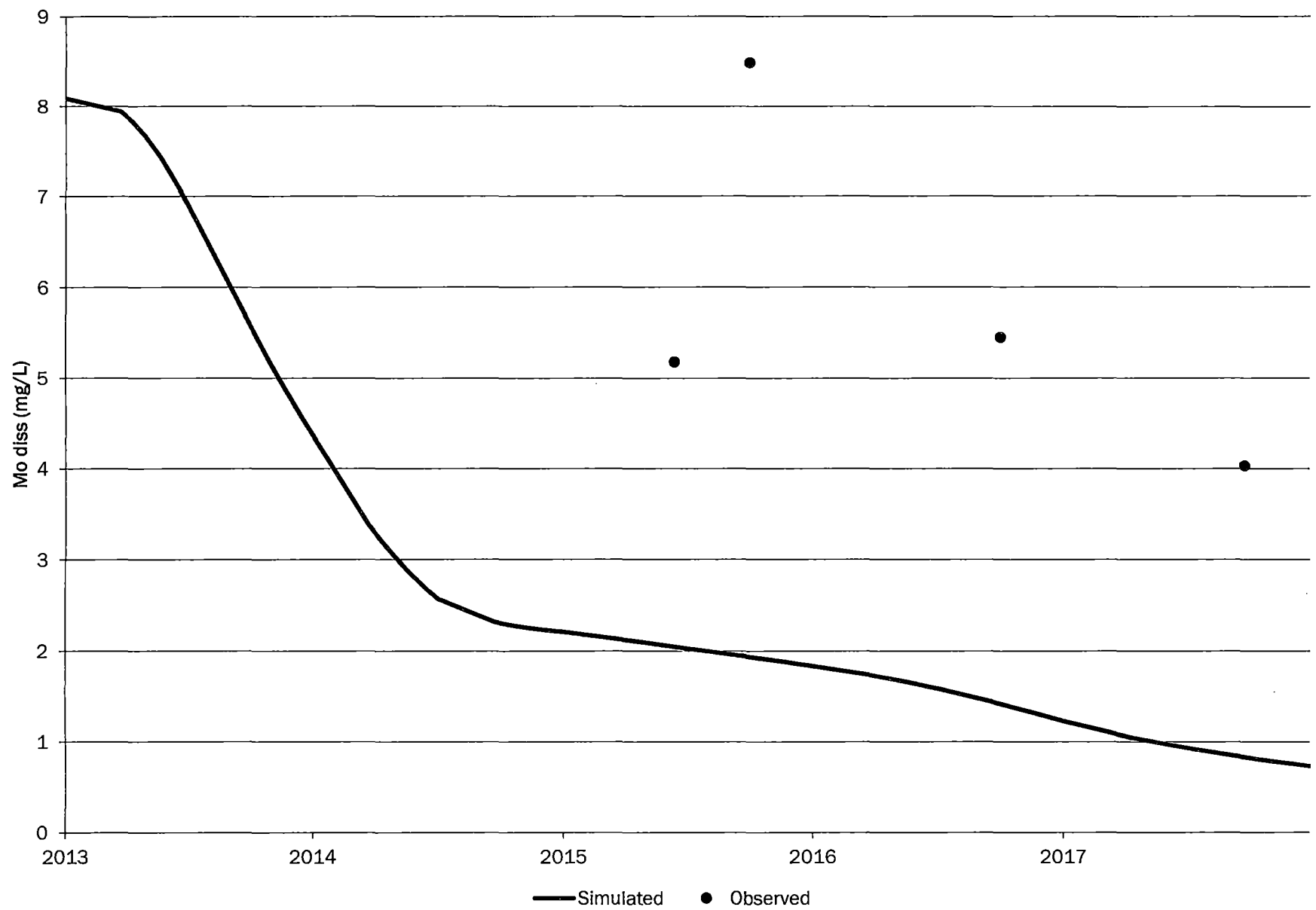
T41-AI



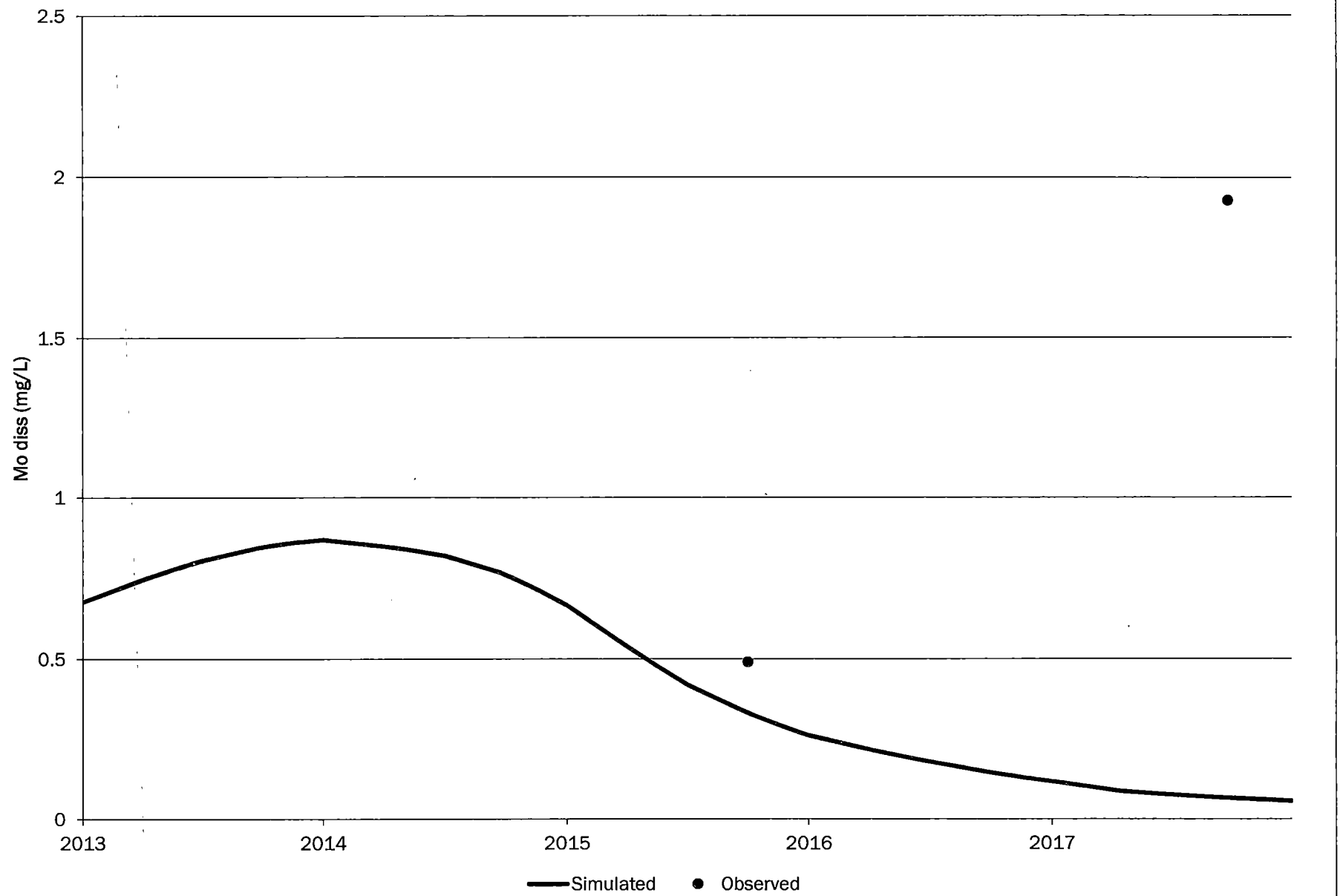
TA-AI



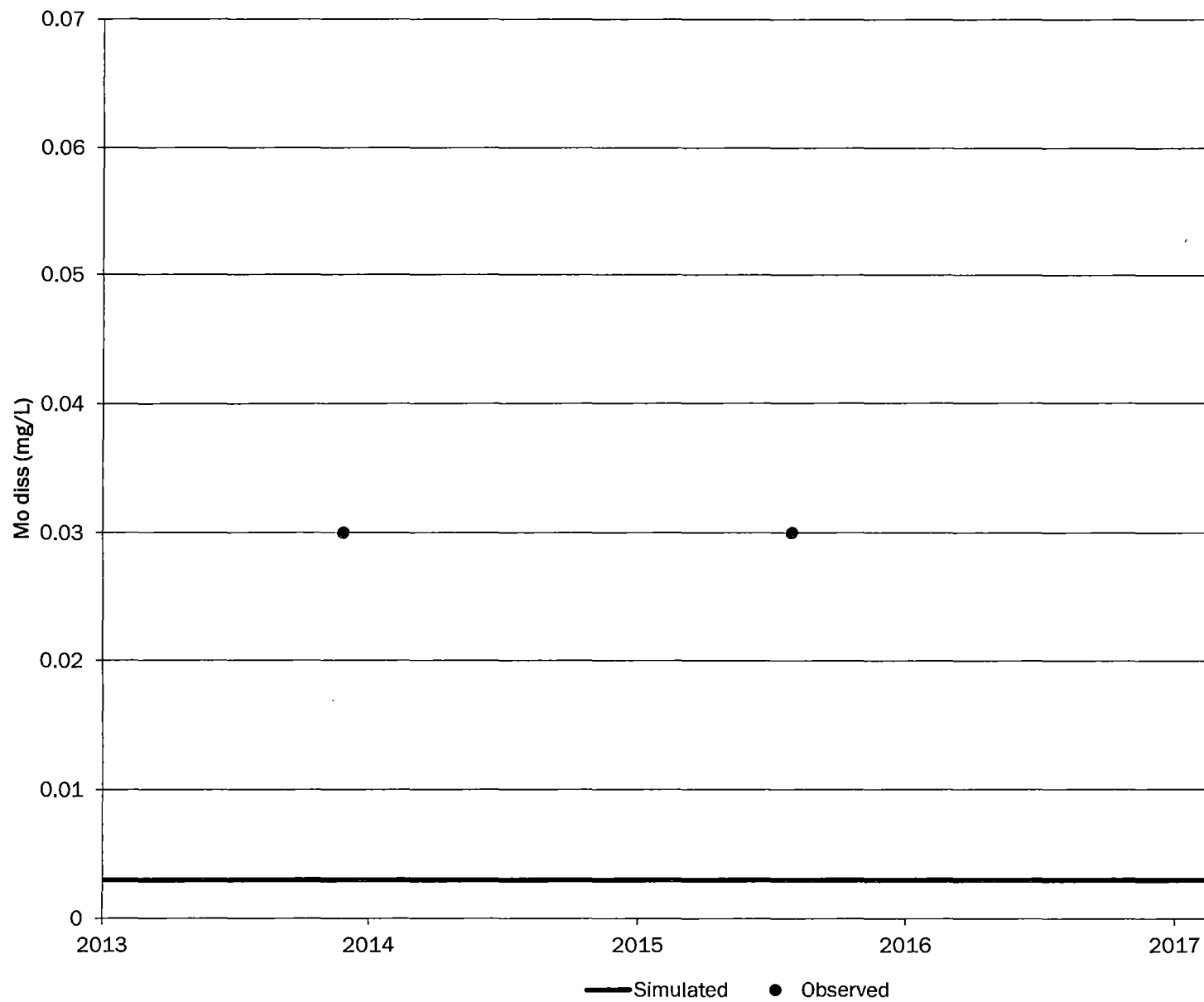
T-AI



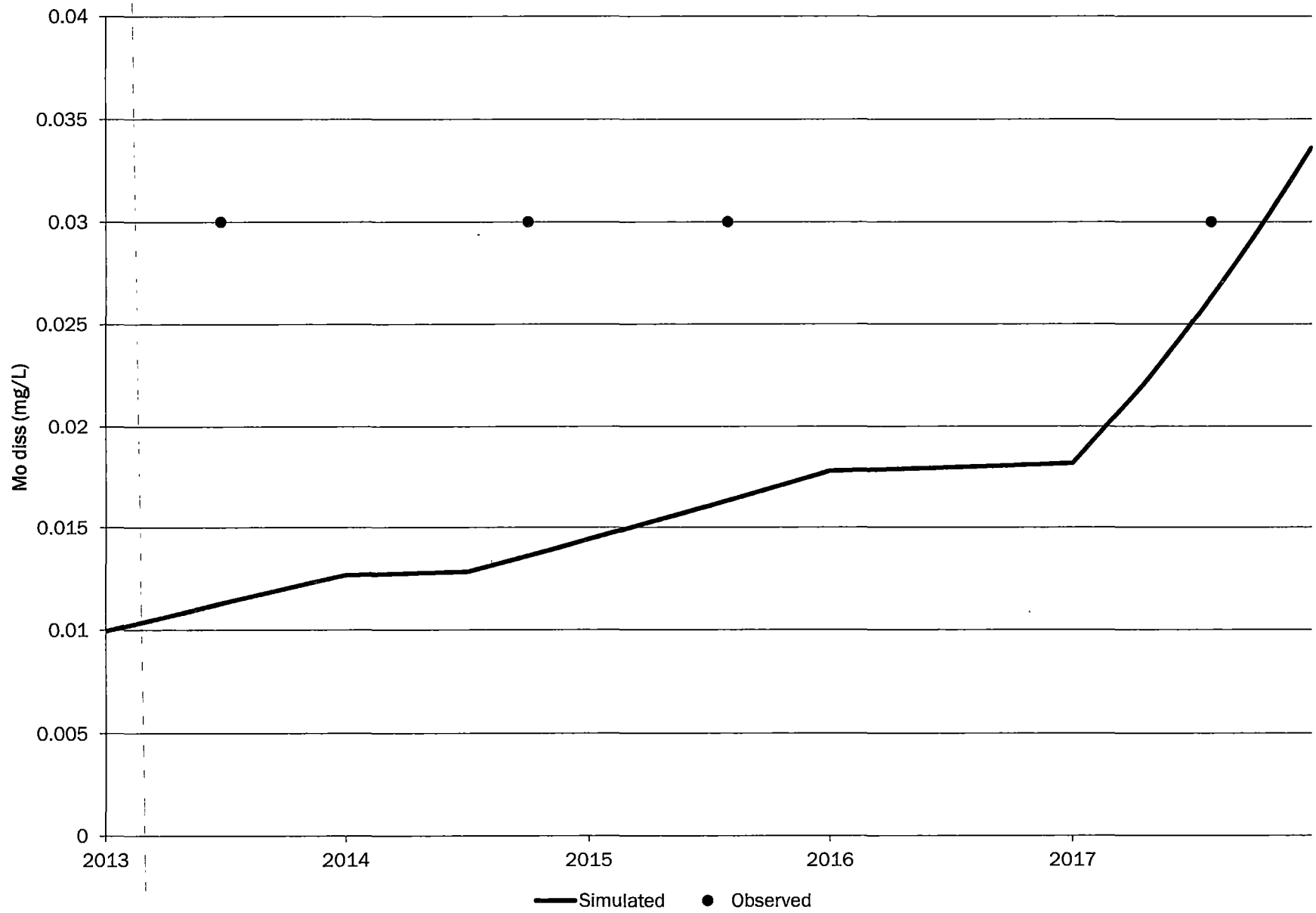
TB-AI



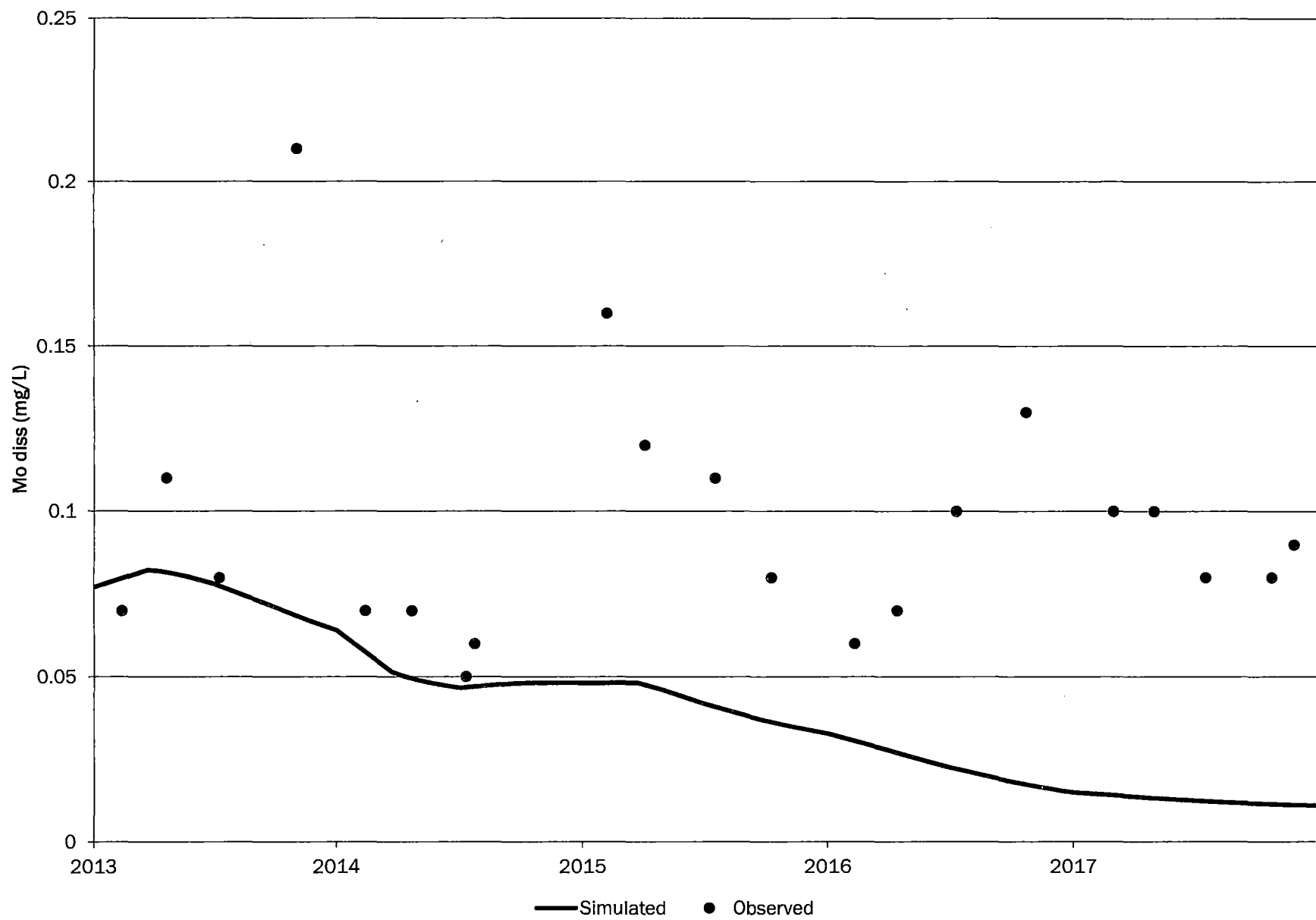
WCW-MC



WR25-MC



X-AI



Appendix D: Uranium Transport Calibration Target Dataset

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Table D-1. Groundwater Transport Model Uranium Calibration Data

Well ID	Easting	Northing	Model Layer	Date	Model Time (days)	Measured Uranium Concentration (mg/L)	Simulated Uranium Concentration (mg/L)	Residual (mg/L)	Weight
0481-AI	490,210	1,536,820	1	5/11/2013	130.6	0.08	0.10	-0.02	1.0
				6/12/2014	527.4	0.06	0.11	-0.04	1.0
0482-AI	489,579	1,536,981	1	7/10/2013	190.5	0.14	0.22	-0.07	1.0
				5/15/2014	499.4	0.15	0.22	-0.07	1.0
0483-AI	489,753	1,536,586	1	11/15/2013	318.7	0.14	0.19	-0.05	1.0
				6/12/2014	527.5	0.13	0.19	-0.05	1.0
				9/11/2014	618.7	0.12	0.18	-0.07	1.0
				5/13/2016	1228.6	0.21	0.18	0.03	1.0
0490-AI	489,752	1,536,553	1	11/5/2013	308.5	0.09	0.19	-0.10	1.0
				11/23/2013	326.4	0.23	0.19	0.03	1.0
				6/12/2014	527.5	0.22	0.19	0.03	1.0
				5/22/2015	871.4	0.13	0.18	-0.05	1.0
				10/16/2015	1018.6	0.07	0.18	-0.11	1.0
				5/13/2016	1228.6	0.08	0.18	-0.09	1.0
				10/22/2016	1390.6	0.25	0.17	0.08	1.0
0491-AI	489,658	1,537,031	1	3/9/2017	1528.0	0.49	0.16	0.33	1.0
				7/10/2013	190.5	0.29	0.23	0.06	1.0
				5/15/2014	499.4	0.27	0.21	0.06	1.0
				9/19/2014	626.4	0.20	0.19	0.01	1.0
0496-AI	489,603	1,534,650	1	9/19/2014	626.4	0.20	0.19	0.00	1.0
				3/7/2013	65.4	0.16	0.19	-0.04	1.0
				11/15/2013	318.6	0.12	0.28	-0.16	1.0
0497-AI	489,503	1,535,039	1	4/2/2014	456.3	0.13	0.31	-0.19	1.0
				6/18/2013	168.5	0.89	0.68	0.21	1.0
				11/15/2013	318.6	0.86	0.51	0.35	1.0
				4/2/2014	456.3	0.75	0.46	0.29	1.0
				6/12/2014	527.5	0.83	0.45	0.38	1.0
				7/11/2014	556.4	0.77	0.45	0.32	1.0
				11/14/2014	682.6	0.80	0.44	0.36	1.0
				12/24/2014	722.4	0.81	0.43	0.37	1.0
				3/5/2016	1159.5	-0.60	0.39	-0.21	1.0
				3/17/2017	1536.0	0.53	0.35	0.18	1.0
				6/27/2017	1638.0	0.52	0.33	0.19	1.0

Table D-1. Groundwater Transport Model Uranium Calibration Data

Well ID	Easting	Northing	Model Layer	Date	Model Time (days)	Measured Uranium Concentration (mg/L)	Simulated Uranium Concentration (mg/L)	Residual (mg/L)	Weight
0498-AI	488,953	1,534,661	1	11/15/2013	318.6	0.50	0.45	0.05	1.0
				6/12/2014	527.5	0.52	0.47	0.05	1.0
				6/10/2015	890.6	0.21	0.41	-0.21	1.0
				7/6/2016	1282.5	0.35	0.39	-0.04	1.0
				8/24/2017	1696.0	0.33	0.36	-0.03	1.0
0522-AI	492,437	1,538,640	1	5/14/2013	133.6	0.51	0.56	-0.04	1.0
				1/29/2014	393.5	0.79	0.46	0.32	1.0
0531-AI	478,262	1,541,086	1	10/14/2015	1016.5	0.10	0.07	0.03	1.0
0532-AI	482,400	1,518,700	1	3/21/2013	79.6	0.00	-1.00	1.00	1.0
				10/23/2014	660.4	0.00	-1.00	1.00	1.0
				10/1/2015	1003.4	0.01	-1.00	1.01	1.0
				12/15/2016	1444.6	0.01	-1.00	1.01	1.0
0538-AI	486,899	1,533,486	1	3/19/2013	77.4	0.17	0.22	-0.05	1.0
				4/2/2014	456.5	0.21	0.18	0.03	1.0
				7/19/2014	564.4	0.22	0.17	0.05	1.0
				8/10/2016	1317.6	0.20	0.10	0.11	1.0
0540-AI	488,091	1,534,125	1	5/4/2013	123.4	0.48	0.45	0.03	1.0
				11/15/2013	318.5	0.49	0.40	0.09	1.0
				10/4/2014	641.5	0.11	0.21	-0.10	1.0
				5/15/2015	864.4	0.05	0.10	-0.05	1.0
				4/29/2016	1214.5	0.02	0.06	-0.04	1.0
				8/5/2016	1312.4	0.14	0.05	0.09	1.0
				11/6/2017	1770.0	0.10	0.05	0.05	1.0
0541-AI	477,236	1,539,831	1	8/9/2013	220.6	0.10	0.12	-0.02	1.0
				7/22/2015	932.6	0.10	0.11	-0.02	1.0
				12/29/2016	1458.6	0.09	0.11	-0.02	1.0
0551-AI	479,880	1,536,272	1	2/7/2013	37.4	0.04	0.04	0.01	1.0
				8/9/2013	220.7	0.05	0.04	0.01	1.0
				2/14/2014	409.6	0.05	0.04	0.01	1.0
				8/28/2014	604.4	0.04	0.04	0.00	1.0
				2/20/2015	780.6	0.04	0.04	0.01	1.0
				2/12/2016	1137.5	0.03	0.03	0.00	1.0
				2/24/2017	1515.0	0.03	0.03	-0.01	1.0
				3/28/2017	1547.0	0.03	0.03	0.00	1.0

Table D-1. Groundwater Transport Model Uranium Calibration Data

Well ID	Easting	Northing	Model Layer	Date	Model Time (days)	Measured Uranium Concentration (mg/L)	Simulated Uranium Concentration (mg/L)	Residual (mg/L)	Weight
0553-AI	480,563	1,534,923	1	2/7/2013	37.4	0.02	0.02	0.00	1.0
				8/9/2013	220.7	0.02	0.02	0.00	1.0
				2/14/2014	409.6	0.03	0.02	0.00	1.0
				8/27/2014	603.6	0.02	0.02	0.00	1.0
				2/20/2015	780.6	0.03	0.02	0.01	1.0
				2/12/2016	1137.5	0.03	0.02	0.00	1.0
				3/27/2017	1546.0	0.03	0.02	0.01	1.0
0554-AI	479,107	1,534,967	1	2/7/2013	37.4	0.02	0.02	0.00	1.0
				8/9/2013	220.6	0.02	0.02	0.00	1.0
				2/14/2014	409.6	0.02	0.02	0.00	1.0
				2/20/2015	780.5	0.02	0.02	0.00	1.0
				3/27/2017	1546.0	0.02	0.02	0.00	1.0
0555-AI	486,236	1,538,572	1	2/6/2013	36.4	0.08	0.08	0.00	1.0
				8/16/2013	227.5	0.09	0.08	0.00	1.0
				2/12/2014	407.6	0.07	0.09	-0.01	1.0
				9/4/2014	611.4	0.05	0.09	-0.04	1.0
				2/26/2015	786.6	0.08	0.09	-0.01	1.0
				2/17/2016	1142.6	0.08	0.10	-0.02	1.0
				3/27/2017	1546.0	0.07	0.10	-0.03	1.0
0556-AI	486,184	1,538,006	1	2/6/2013	36.4	0.06	0.06	0.00	1.0
				8/16/2013	227.5	0.06	0.07	0.00	1.0
				2/12/2014	407.6	0.07	0.07	0.00	1.0
				9/4/2014	611.4	0.07	0.07	0.00	1.0
				2/26/2015	786.6	0.06	0.07	-0.01	1.0
				2/11/2016	1136.6	0.31	0.08	0.23	1.0
				3/27/2017	1546.0	0.07	0.08	-0.01	1.0
0557-AI	486,000	1,537,204	1	2/6/2013	36.5	0.05	0.05	0.00	1.0
				8/16/2013	227.6	0.05	0.05	0.00	1.0
				2/12/2014	407.6	0.06	0.05	0.00	1.0
				9/4/2014	611.4	0.05	0.05	0.00	1.0
				2/26/2015	786.6	0.05	0.05	0.00	1.0
				2/11/2016	1136.6	0.05	0.05	0.00	1.0
				3/27/2017	1546.0	0.05	0.05	0.00	1.0
0631-AI	483,756	1,532,234	1	3/7/2013	65.5	0.09	0.08	0.01	1.0

Table D-1. Groundwater Transport Model Uranium Calibration Data

Well ID	Easting	Northing	Model Layer	Date	Model Time (days)	Measured Uranium Concentration (mg/L)	Simulated Uranium Concentration (mg/L)	Residual (mg/L)	Weight
				4/2/2014	456.4	0.12	0.08	0.03	1.0
				12/28/2016	1457.4	0.15	0.07	0.09	1.0
				6/30/2017	1641.0	0.16	0.07	0.09	1.0
0632-AI	483,767	1,531,850	1	3/7/2013	65.5	0.09	0.06	0.02	1.0
				4/2/2014	456.4	0.09	0.07	0.02	1.0
				6/30/2017	1641.0	0.13	0.05	0.08	1.0
0634-AI	480,362	1,541,652	1	11/24/2013	327.5	0.26	0.26	0.00	1.0
				7/30/2014	575.4	0.25	0.22	0.03	1.0
				4/23/2015	842.4	0.23	0.18	0.05	1.0
				5/6/2015	855.5	0.27	0.18	0.08	1.0
				6/17/2015	897.4	0.24	0.18	0.06	1.0
				8/20/2015	961.5	0.25	0.17	0.07	1.0
				9/30/2015	1002.5	0.25	0.17	0.08	1.0
				1/12/2016	1106.4	0.22	0.16	0.06	1.0
				2/19/2016	1144.6	0.19	0.16	0.03	1.0
				4/6/2016	1191.6	0.19	0.15	0.04	1.0
				7/24/2016	1300.5	0.22	0.13	0.08	1.0
				10/22/2016	1390.6	0.19	0.11	0.07	1.0
				12/1/2016	1430.5	0.15	0.11	0.04	1.0
				3/20/2017	1539.0	0.16	0.10	0.05	1.0
				7/11/2017	1652.0	0.15	0.11	0.04	1.0
				12/13/2017	1807.0	0.09	0.12	-0.03	1.0
0636-AI	476,038	1,545,374	1	12/19/2014	717.6	0.06	0.05	0.01	1.0
0637-AI	474,710	1,545,409	1	12/12/2014	710.6	0.07	0.09	-0.01	1.0
				12/21/2016	1450.6	0.06	0.08	-0.02	1.0
				10/6/2017	1739.0	0.06	0.08	-0.02	1.0
0641-AI	491,110	1,536,494	1	7/1/2015	911.7	0.03	0.07	-0.04	1.0
0642-AI	490,932	1,536,104	1	7/1/2015	911.7	0.07	0.14	-0.07	1.0
0644-AI	485,450	1,533,481	1	10/11/2014	648.6	0.06	0.13	-0.07	1.0
				8/2/2016	1309.6	0.04	0.06	-0.02	1.0
0646-AI	484,952	1,533,246	1	9/4/2014	611.4	0.08	0.11	-0.04	1.0
				8/2/2016	1309.5	0.05	0.07	-0.02	1.0
				11/14/2017	1778.0	0.05	0.05	0.00	1.0
0647-AI	478,308	1,536,623	1	2/7/2013	37.5	0.05	0.04	0.00	1.0

Table D-1. Groundwater Transport Model Uranium Calibration Data

Well ID	Easting	Northing	Model Layer	Date	Model Time (days)	Measured Uranium Concentration (mg/L)	Simulated Uranium Concentration (mg/L)	Residual (mg/L)	Weight
				8/9/2013	220.6	0.04	0.04	0.00	1.0
				8/28/2014	604.4	0.04	0.04	0.00	1.0
				9/14/2017	1717.0	0.08	0.04	0.04	1.0
0649-AI	479,798	1,534,730	1	2/7/2013	37.4	0.03	0.02	0.00	1.0
				3/7/2013	65.5	0.02	0.02	0.00	1.0
				8/16/2013	227.6	0.02	0.02	0.00	1.0
				4/2/2014	456.6	0.03	0.02	0.01	1.0
				3/5/2015	793.5	0.03	0.02	0.01	1.0
				2/23/2016	1148.5	0.03	0.02	0.01	1.0
				3/15/2017	1534.0	0.03	0.02	0.00	1.0
0650-AI	482,135	1,536,779	1	2/7/2013	37.5	0.03	0.03	0.00	1.0
				8/16/2013	227.6	0.03	0.03	0.00	1.0
				2/26/2014	421.5	0.03	0.03	0.00	1.0
				9/4/2014	611.6	0.03	0.03	0.01	1.0
				3/18/2015	806.4	0.03	0.03	0.01	1.0
				2/12/2016	1137.6	0.03	0.03	0.00	1.0
				3/27/2017	1546.0	0.03	0.03	0.01	1.0
0653-AI	486,570	1,533,283	1	6/18/2013	168.5	0.28	0.22	0.06	1.0
				11/15/2013	318.6	0.28	0.21	0.08	1.0
				7/19/2014	564.5	0.26	0.19	0.07	1.0
				8/2/2016	1309.6	0.27	0.13	0.14	1.0
0654-AI	478,636	1,541,994	1	6/10/2015	890.6	0.10	0.13	-0.03	1.0
				11/14/2017	1778.0	0.12	0.14	-0.02	1.0
0657-AI	478,392	1,537,497	1	5/14/2013	133.6	0.06	0.06	0.01	1.0
				8/9/2013	220.6	0.06	0.06	0.00	1.0
0658-AI	478,436	1,535,922	1	2/7/2013	37.5	0.01	0.02	-0.01	1.0
				10/30/2013	302.4	0.01	0.02	-0.01	1.0
				2/26/2014	421.4	0.01	0.02	-0.01	1.0
				8/27/2014	603.6	0.01	0.02	-0.01	1.0
				2/20/2015	780.5	0.02	0.02	0.00	1.0
				2/21/2017	1512.0	0.01	0.02	-0.01	1.0
0659-AI	480,772	1,541,689	1	4/23/2015	842.4	0.27	0.19	0.08	1.0
				5/6/2015	855.5	0.30	0.19	0.11	1.0
				6/17/2015	897.4	0.28	0.18	0.09	1.0

Table D-1. Groundwater Transport Model Uranium Calibration Data

Well ID	Easting	Northing	Model Layer	Date	Model Time (days)	Measured Uranium Concentration (mg/L)	Simulated Uranium Concentration (mg/L)	Residual (mg/L)	Weight
				8/20/2015	961.6	0.27	0.18	0.09	1.0
				9/30/2015	1002.4	0.28	0.17	0.10	1.0
				2/19/2016	1144.5	0.26	0.17	0.09	1.0
				2/24/2016	1149.3	0.25	0.17	0.09	1.0
				4/6/2016	1191.6	0.25	0.16	0.08	1.0
				7/24/2016	1300.5	0.22	0.16	0.07	1.0
				10/22/2016	1390.6	0.21	0.15	0.06	1.0
				3/20/2017	1539.0	0.19	0.14	0.05	1.0
0681-AI	482,734	1,540,676	1	3/19/2013	77.5	0.05	0.05	0.00	1.0
				3/27/2015	815.6	0.05	0.05	0.00	1.0
0684-AI	478,499	1,540,273	1	10/14/2015	1016.5	0.09	0.06	0.03	1.0
0686-AI	475,438	1,545,319	1	12/12/2014	710.6	0.06	0.07	-0.01	1.0
				12/21/2016	1450.6	0.06	0.06	0.00	1.0
				10/6/2017	1739.0	0.06	0.06	0.00	1.0
0688-AI	483,954	1,541,257	1	3/5/2013	63.5	0.06	0.05	0.00	1.0
				10/30/2013	302.6	0.06	0.05	0.01	1.0
				3/20/2014	443.6	0.06	0.05	0.01	1.0
				3/13/2015	801.6	0.04	0.05	-0.01	1.0
				3/17/2016	1171.4	0.05	0.05	0.00	1.0
				3/27/2017	1546.0	0.05	0.05	0.00	1.0
				8/9/2017	1681.0	0.04	0.05	-0.01	1.0
0690-AI	493,465	1,540,279	1	2/20/2013	50.6	0.12	0.15	-0.02	1.0
				4/25/2017	1575.0	0.12	0.14	-0.02	1.0
0691-AI	493,860	1,540,276	1	2/20/2013	50.5	0.02	0.03	-0.01	1.0
				4/25/2017	1575.0	0.02	0.02	-0.01	1.0
0692-AI	493,175	1,535,892	1	7/1/2015	911.4	0.06	0.02	0.03	1.0
0802-AI	488,277	1,540,765	1	3/5/2013	63.4	0.23	0.21	0.02	1.0
				3/19/2014	442.3	0.19	0.12	0.07	1.0
				3/19/2014	442.3	0.19	0.12	0.07	1.0
				9/9/2014	616.7	0.18	0.10	0.08	1.0
				3/20/2015	808.5	0.10	0.08	0.02	1.0
				8/7/2015	948.5	0.15	0.07	0.08	1.0
				3/16/2016	1170.4	0.16	0.06	0.10	1.0
				9/9/2016	1347.6	0.11	0.06	0.05	1.0

Table D-1. Groundwater Transport Model Uranium Calibration Data

Well ID	Easting	Northing	Model Layer	Date	Model Time (days)	Measured Uranium Concentration (mg/L)	Simulated Uranium Concentration (mg/L)	Residual (mg/L)	Weight
				3/14/2017	1533.0	0.10	0.06	0.04	1.0
				8/9/2017	1681.0	0.21	0.05	0.15	1.0
0844-AI	487,002	1,538,376	1	2/6/2013	36.4	0.13	0.15	-0.02	1.0
				8/16/2013	227.4	0.12	0.15	-0.02	1.0
				2/26/2014	421.4	0.11	0.14	-0.03	1.0
				9/4/2014	611.4	0.12	0.13	-0.01	1.0
				2/26/2015	786.5	0.09	0.12	-0.03	1.0
				2/20/2016	1145.5	0.09	0.10	-0.01	1.0
				3/27/2017	1546.0	0.10	0.09	0.01	1.0
0845-AI	487,833	1,537,280	1	2/6/2013	36.4	0.07	0.06	0.01	1.0
				8/16/2013	227.6	0.08	0.06	0.02	1.0
				2/26/2014	421.4	0.08	0.06	0.02	1.0
				9/4/2014	611.4	0.07	0.06	0.01	1.0
				2/26/2015	786.5	0.08	0.06	0.02	1.0
				2/20/2016	1145.5	0.07	0.06	0.00	1.0
				3/27/2017	1546.0	0.08	0.07	0.01	1.0
0846-AI	484,730	1,537,219	1	2/20/2013	50.4	0.10	0.11	-0.01	1.0
				2/20/2013	50.4	0.09	0.11	-0.02	1.0
				10/30/2013	302.6	0.06	0.11	-0.04	1.0
				2/26/2014	421.4	0.07	0.11	-0.04	1.0
				9/4/2014	611.5	0.06	0.10	-0.05	1.0
				3/18/2015	806.4	0.06	0.10	-0.05	1.0
				7/1/2015	911.4	0.06	0.10	-0.04	1.0
				8/20/2015	961.6	0.06	0.10	-0.04	1.0
				2/12/2016	1137.4	0.08	0.10	-0.01	1.0
				3/27/2017	1546.0	0.06	0.09	-0.04	1.0
				8/9/2017	1681.0	0.06	0.09	-0.03	1.0
0852-AI	493,989	1,535,610	1	7/1/2015	911.4	0.02	0.02	0.00	1.0
0862-AI	487,800	1,534,265	1	5/4/2013	123.5	0.29	0.34	-0.06	1.0
				1/29/2014	393.6	0.27	0.39	-0.12	1.0
				6/12/2014	527.5	0.29	0.39	-0.10	1.0
				10/18/2014	655.4	0.18	0.28	-0.10	1.0
				5/15/2015	864.5	0.19	0.10	0.09	1.0
				5/7/2016	1222.5	0.13	0.05	0.08	1.0

Table D-1. Groundwater Transport Model Uranium Calibration Data

Well ID	Easting	Northing	Model Layer	Date	Model Time (days)	Measured Uranium Concentration (mg/L)	Simulated Uranium Concentration (mg/L)	Residual (mg/L)	Weight
				8/5/2016	1312.3	0.10	0.04	0.06	1.0
				10/25/2016	1393.5	0.11	0.04	0.07	1.0
				12/1/2016	1430.6	0.10	0.04	0.06	1.0
				3/21/2017	1540.0	0.09	0.03	0.06	1.0
0864-AI	486,464	1,533,735	1	2/26/2013	56.6	0.23	0.19	0.04	1.0
				8/21/2015	962.4	0.26	0.11	0.15	1.0
				8/10/2016	1317.4	0.19	0.10	0.09	1.0
				8/18/2017	1690.0	0.17	0.09	0.07	1.0
0865-AI	488,429	1,534,123	1	10/18/2014	655.4	0.17	0.12	0.05	1.0
				5/15/2015	864.4	0.10	0.08	0.03	1.0
				8/21/2015	962.5	0.07	0.06	0.02	1.0
				4/29/2016	1214.5	0.05	0.04	0.01	1.0
				8/5/2016	1312.4	0.06	0.04	0.02	1.0
0866-AI	488,340	1,534,494	1	5/4/2013	123.4	0.66	0.52	0.14	1.0
				8/6/2014	582.7	0.64	0.44	0.19	1.0
				9/12/2014	619.7	0.60	0.41	0.18	1.0
				10/18/2014	655.4	0.56	0.38	0.18	1.0
				10/22/2014	659.6	0.59	0.38	0.21	1.0
				11/14/2014	682.6	0.52	0.36	0.16	1.0
				12/24/2014	722.5	0.46	0.33	0.12	1.0
				8/21/2015	962.4	0.61	0.22	0.39	1.0
				8/5/2016	1312.5	0.60	0.16	0.44	1.0
				12/1/2016	1430.6	0.45	0.13	0.32	1.0
				3/21/2017	1540.0	0.36	0.13	0.23	1.0
				8/17/2017	1689.0	0.34	0.16	0.19	1.0
0868-AI	491,033	1,534,848	1	7/1/2015	911.4	0.07	0.04	0.02	1.0
0869-AI	486,073	1,533,251	1	3/19/2013	77.4	0.28	0.24	0.04	1.0
				6/18/2013	168.6	0.29	0.22	0.07	1.0
				7/19/2014	564.5	0.28	0.15	0.13	1.0
0881-AI	481,478	1,542,034	1	2/9/2013	39.5	0.37	0.35	0.02	1.0
				10/31/2013	303.4	0.34	0.32	0.02	1.0
				2/12/2014	407.4	0.28	0.30	-0.02	1.0
				8/27/2014	603.4	0.33	0.29	0.04	1.0
				2/27/2015	787.5	0.35	0.30	0.05	1.0

Table D-1. Groundwater Transport Model Uranium Calibration Data

Well ID	Easting	Northing	Model Layer	Date	Model Time (days)	Measured Uranium Concentration (mg/L)	Simulated Uranium Concentration (mg/L)	Residual (mg/L)	Weight
				2/19/2016	1144.4	0.31	0.32	-0.01	1.0
				2/23/2017	1514.0	0.23	0.33	-0.10	1.0
0882-AI	482,396	1,541,404	1	2/12/2013	42.6	0.05	0.05	0.00	1.0
				8/9/2013	220.4	0.06	0.05	0.01	1.0
				2/12/2014	407.4	0.06	0.05	0.01	1.0
				8/27/2014	603.5	0.06	0.05	0.01	1.0
				2/27/2015	787.5	0.07	0.05	0.01	1.0
				2/19/2016	1144.5	0.06	0.05	0.01	1.0
				3/15/2017	1534.0	0.06	0.05	0.01	1.0
0884-AI	481,498	1,542,677	1	2/9/2013	39.5	0.04	0.04	0.00	1.0
				8/9/2013	220.4	0.04	0.05	-0.01	1.0
				2/12/2014	407.4	0.03	0.05	-0.02	1.0
				8/6/2014	582.6	0.03	0.06	-0.03	1.0
				2/27/2015	787.4	0.04	0.07	-0.04	1.0
				2/19/2016	1144.4	0.03	0.09	-0.06	1.0
				3/27/2017	1546.0	0.02	0.11	-0.08	1.0
0885-AI	483,474	1,541,919	1	8/9/2013	220.5	0.11	0.09	0.02	1.0
				10/23/2014	660.6	0.13	0.11	0.02	1.0
				3/29/2017	1548.0	0.07	0.15	-0.08	1.0
				10/4/2017	1737.0	0.07	0.15	-0.08	1.0
0886-AI	482,487	1,542,327	1	2/9/2013	39.5	0.31	0.36	-0.05	1.0
				11/16/2013	319.5	0.63	0.40	0.22	1.0
				2/12/2014	407.4	0.16	0.40	-0.24	1.0
				10/17/2014	654.4	0.22	0.38	-0.17	1.0
				2/27/2015	787.5	0.23	0.37	-0.14	1.0
				2/19/2016	1144.4	0.32	0.36	-0.05	1.0
				7/8/2016	1284.6	0.32	0.36	-0.04	1.0
				3/3/2017	1522.0	0.29	0.35	-0.06	1.0
				11/9/2017	1773.0	0.35	0.34	0.01	1.0
0887-AI	482,469	1,543,063	1	3/20/2013	78.5	0.03	0.03	0.00	1.0
				10/17/2014	654.4	0.07	0.03	0.04	1.0
				3/25/2015	813.6	0.03	0.03	0.00	1.0
0888-AI	479,335	1,542,285	1	3/20/2013	78.4	0.17	0.16	0.01	1.0
				8/9/2013	220.5	0.20	0.14	0.06	1.0

Table D-1. Groundwater Transport Model Uranium Calibration Data

Well ID	Easting	Northing	Model Layer	Date	Model Time (days)	Measured Uranium Concentration (mg/L)	Simulated Uranium Concentration (mg/L)	Residual (mg/L)	Weight
				3/25/2015	813.6	0.18	0.14	0.04	1.0
				2/10/2016	1135.5	0.17	0.15	0.02	1.0
				3/28/2017	1547.0	0.14	0.14	0.00	1.0
				10/6/2017	1739.0	0.13	0.17	-0.04	1.0
0890-AI	480,088	1,541,365	1	5/1/2013	120.7	0.27	0.23	0.04	1.0
				7/30/2014	575.6	0.21	0.13	0.08	1.0
				4/23/2015	842.4	0.18	0.08	0.10	1.0
				5/6/2015	855.4	0.21	0.08	0.13	1.0
				6/17/2015	897.4	0.18	0.07	0.11	1.0
				8/20/2015	961.5	0.19	0.07	0.12	1.0
				9/30/2015	1002.5	0.20	0.07	0.13	1.0
				1/12/2016	1106.4	0.14	0.06	0.07	1.0
				2/19/2016	1144.5	0.15	0.07	0.09	1.0
				4/6/2016	1191.6	0.14	0.07	0.07	1.0
				7/24/2016	1300.5	0.16	0.06	0.10	1.0
				10/22/2016	1390.6	0.11	0.06	0.05	1.0
				5/17/2017	1597.0	0.05	0.05	0.00	1.0
				7/11/2017	1652.0	0.12	0.05	0.07	1.0
				12/13/2017	1807.0	0.06	0.06	0.00	1.0
0891-AI	493,751	1,540,904	1	2/20/2013	50.6	0.05	-0.40	0.46	1.0
				4/25/2017	1575.0	0.20	-0.40	0.60	1.0
0893-AI	482,244	1,541,934	1	2/12/2013	42.6	0.19	0.20	-0.01	1.0
				8/9/2013	220.4	0.18	0.23	-0.05	1.0
				2/12/2014	407.4	0.31	0.26	0.05	1.0
				8/27/2014	603.6	0.22	0.29	-0.07	1.0
				3/13/2015	801.6	0.23	0.29	-0.06	1.0
				2/20/2016	1145.4	0.11	0.28	-0.17	1.0
				3/14/2017	1533.0	0.08	0.28	-0.20	1.0
0899-AI	477,288	1,543,801	1	6/10/2015	890.6	0.12	0.05	0.06	1.0
				10/3/2017	1736.0	0.07	0.05	0.02	1.0
0910-AI	481,150	1,528,800	1	12/12/2013	345.6	0.01	0.02	-0.01	1.0
				10/23/2014	660.4	0.01	0.02	-0.01	1.0
				10/1/2015	1003.5	0.01	0.02	-0.01	1.0
0920-AI	496,900	1,555,800	1	2/26/2014	421.6	0.23	0.23	0.00	1.0

Table D-1. Groundwater Transport Model Uranium Calibration Data

Well ID	Easting	Northing	Model Layer	Date	Model Time (days)	Measured Uranium Concentration (mg/L)	Simulated Uranium Concentration (mg/L)	Residual (mg/L)	Weight
				9/19/2014	626.6	0.22	0.23	-0.02	1.0
				10/23/2014	660.5	0.23	0.23	0.00	1.0
				3/5/2015	793.5	0.23	0.23	0.00	1.0
				4/14/2016	1199.4	0.24	0.23	0.01	1.0
				10/7/2016	1375.4	0.22	0.23	-0.02	1.0
				3/3/2017	1522.0	0.20	0.23	-0.04	1.0
				8/10/2017	1682.0	0.23	0.23	0.00	1.0
0921-AI	495,800	1,555,400	1	10/8/2014	645.7	0.22	0.09	0.13	1.0
				10/8/2014	645.7	0.22	0.09	0.13	1.0
				10/23/2014	660.6	0.22	0.09	0.13	1.0
				12/11/2017	1805.0	0.21	0.06	0.15	1.0
0922-AI	492,500	1,555,200	1	10/23/2014	660.5	0.00	-1.00	1.00	1.0
0935-AI	476,629	1,540,115	1	12/12/2013	345.6	0.14	0.12	0.02	1.0
				10/14/2015	1016.6	0.11	0.12	0.00	1.0
0994-AI	476,240	1,539,700	1	4/5/2013	94.4	0.01	0.01	0.00	1.0
				10/31/2013	303.4	0.01	0.01	-0.01	1.0
				3/28/2014	451.4	0.01	0.02	-0.01	1.0
				10/2/2014	639.4	0.01	0.03	-0.02	1.0
				4/10/2015	829.4	0.01	0.04	-0.03	1.0
				10/20/2015	1022.4	0.01	0.05	-0.04	1.0
				8/24/2017	1696.0	0.01	0.08	-0.07	1.0
0996-AI	477,989	1,537,621	1	8/9/2013	220.6	0.08	-0.07	0.15	1.0
				12/16/2016	1445.6	0.08	-0.08	0.16	1.0
				10/4/2017	1737.0	0.07	-0.37	0.44	1.0
0999-AI	480,187	1,524,230	1	3/21/2013	79.6	0.00	0.01	0.00	1.0
				10/23/2014	660.4	0.00	0.01	0.00	1.0
				10/1/2015	1003.4	0.01	0.01	0.01	1.0
				12/16/2016	1445.4	0.01	0.01	0.00	1.0
1F-AI	493,831	1,544,952	1	9/30/2016	1368.4	1.00	2.62	-1.62	1.0
				9/19/2017	1722.0	1.12	2.23	-1.11	1.0
1J-AI	493,695	1,541,986	1	1/23/2013	22.4	0.03	0.28	-0.24	1.0
				1/29/2014	393.5	-0.08	0.13	-0.05	1.0
				2/5/2015	765.6	0.01	0.09	-0.08	1.0
				1/22/2016	1116.6	0.00	0.07	-0.07	1.0

Table D-1. Groundwater Transport Model Uranium Calibration Data

Well ID	Easting	Northing	Model Layer	Date	Model Time (days)	Measured Uranium Concentration (mg/L)	Simulated Uranium Concentration (mg/L)	Residual (mg/L)	Weight
				1/24/2017	1484.0	0.03	0.07	-0.04	1.0
1M-AI	493,133	1,541,327	1	9/30/2016	1368.5	0.18	0.12	0.06	1.0
				3/22/2017	1541.0	0.14	0.12	0.03	1.0
1N-AI	494,396	1,543,100	1	2/20/2013	50.6	0.07	-1.00	1.07	1.0
				6/26/2014	541.5	0.07	-1.00	1.07	1.0
				2/20/2015	780.6	0.08	-1.00	1.08	1.0
				3/22/2017	1541.0	0.06	-1.00	1.06	1.0
1P-AI	493,924	1,541,902	1	2/20/2013	50.6	0.09	-0.21	0.30	1.0
				6/26/2014	541.6	0.59	-0.24	0.83	1.0
				2/20/2015	780.7	0.22	-0.25	0.48	1.0
				3/22/2017	1541.0	0.15	-0.27	0.41	1.0
1Q-AI	493,619	1,541,993	1	1/23/2013	22.4	1.46	0.14	1.32	1.0
				1/29/2014	393.5	0.56	-0.03	0.59	1.0
				2/5/2015	765.6	0.13	0.09	0.03	1.0
				1/21/2016	1115.4	0.15	0.08	0.07	1.0
				1/16/2017	1476.0	0.09	0.05	0.03	1.0
1R-AI	493,623	1,542,071	1	1/17/2013	16.6	0.01	-0.71	0.73	1.0
				1/29/2014	393.5	0.10	-0.77	0.86	1.0
				2/4/2015	764.6	0.12	-0.77	0.89	1.0
				1/21/2016	1115.5	0.15	-0.77	0.93	1.0
				1/16/2017	1476.0	0.10	-0.77	0.88	1.0
1S-AI	493,614	1,541,920	1	1/22/2013	21.5	0.02	0.15	-0.13	1.0
				1/29/2014	393.5	0.08	0.08	0.00	1.0
				2/5/2015	765.6	0.01	0.06	-0.05	1.0
				1/22/2016	1116.6	0.00	0.06	-0.05	1.0
				1/24/2017	1484.0	0.02	0.06	-0.03	1.0
1T-AI	493,656	1,541,990	1	1/17/2013	16.5	0.36	0.33	0.03	1.0
				1/28/2014	392.5	0.05	0.12	-0.07	1.0
				2/5/2015	765.6	0.16	0.09	0.07	1.0
				1/21/2016	1115.4	0.15	0.08	0.08	1.0
				1/16/2017	1476.0	0.07	0.07	0.00	1.0
1U-AI	493,542	1,542,001	1	1/17/2013	16.5	0.99	-0.84	1.82	1.0
				2/21/2013	51.4	1.62	-0.85	2.47	1.0
				1/29/2014	393.4	0.30	-0.87	1.17	1.0

Table D-1. Groundwater Transport Model Uranium Calibration Data

Well ID	Easting	Northing	Model Layer	Date	Model Time (days)	Measured Uranium Concentration (mg/L)	Simulated Uranium Concentration (mg/L)	Residual (mg/L)	Weight
				2/4/2015	764.6	0.25	0.28	-0.03	1.0
				1/21/2016	1115.5	0.24	-0.47	0.71	1.0
				1/16/2017	1476.0	0.19	-0.53	0.72	1.0
1V-AI	493,579	1,541,982	1	1/17/2013	16.5	2.21	-0.59	2.80	1.0
				1/28/2014	392.6	0.21	-0.65	0.86	1.0
				2/5/2015	765.6	0.39	0.13	0.26	1.0
				1/21/2016	1115.4	0.22	0.09	0.13	1.0
				1/16/2017	1476.0	0.21	-0.03	0.24	1.0
AW-AI	488,015	1,540,235	1	12/10/2013	343.6	0.14	0.14	0.00	1.0
				10/11/2014	648.5	0.12	0.16	-0.04	1.0
				10/24/2015	1026.6	0.10	0.18	-0.08	1.0
				12/20/2016	1449.4	0.07	0.17	-0.10	1.0
				11/30/2017	1794.0	0.10	0.15	-0.05	1.0
B10-AI	491,133	1,542,517	1	11/24/2013	327.4	30.5	16.1	14.4	1.0
				5/2/2017	1582.0	7.47	8.33	-0.86	1.0
B11-AI	491,329	1,542,517	1	6/13/2015	893.4	17.8	9.01	8.79	1.0
				5/2/2017	1582.0	6.22	5.27	0.95	1.0
B12-AI	488,915	1,542,524	1	5/15/2013	134.4	0.85	1.44	-0.59	1.0
				6/26/2014	541.6	2.07	1.04	1.03	1.0
				2/6/2015	766.6	1.50	0.29	1.21	1.0
				3/19/2016	1173.5	4.13	0.12	4.01	1.0
				11/13/2017	1777.0	1.74	0.17	1.57	1.0
B13-AI	490,223	1,541,841	1	5/15/2013	134.4	1.08	0.40	0.68	1.0
				2/6/2015	766.6	0.48	0.08	0.40	1.0
				3/28/2017	1547.0	0.98	0.07	0.91	1.0
B4-AI	489,942	1,542,471	1	6/13/2015	893.4	20.6	19.0	1.63	1.0
				5/2/2017	1582.0	13.6	7.87	5.73	1.0
B5-AI	490,141	1,542,474	1	6/13/2015	893.4	28.2	13.7	14.5	1.0
				5/1/2017	1581.0	6.97	8.60	-1.63	1.0
B6-AI	490,341	1,542,478	1	11/24/2013	327.4	25.6	10.5	15.1	1.0
				6/13/2015	893.4	6.49	11.5	-5.04	1.0
B7-AI	490,540	1,542,488	1	6/19/2013	169.6	1.08	12.5	-11.5	1.0
				11/24/2013	327.5	31.2	14.6	16.6	1.0
				6/13/2015	893.4	6.13	14.9	-8.81	1.0

Table D-1. Groundwater Transport Model Uranium Calibration Data

Well ID	Easting	Northing	Model Layer	Date	Model Time (days)	Measured Uranium Concentration (mg/L)	Simulated Uranium Concentration (mg/L)	Residual (mg/L)	Weight
				5/2/2017	1582.0	7.14	11.9	-4.77	1.0
B8-AI	490,734	1,542,488	1	6/13/2015	893.4	13.4	17.9	-4.54	1.0
				5/2/2017	1582.0	6.54	12.9	-6.36	1.0
B9-AI	490,935	1,542,514	1	6/13/2015	893.4	8.78	16.0	-7.23	1.0
				5/1/2017	1581.0	9.82	11.0	-1.17	1.0
B-AI	489,311	1,541,684	1	6/19/2014	534.4	0.11	0.03	0.08	1.0
				5/22/2015	871.5	0.08	0.03	0.06	1.0
BC-AI	487,910	1,543,655	1	6/19/2014	534.4	1.20	0.64	0.56	1.0
				5/22/2015	871.5	0.92	0.35	0.57	1.0
				6/27/2017	1638.0	1.16	0.23	0.93	1.0
C10-AI	491,629	1,542,182	1	3/8/2013	66.4	11.0	9.80	1.20	1.0
				11/1/2013	304.4	5.80	8.37	-2.57	1.0
				3/27/2014	450.6	9.72	7.56	2.16	1.0
				9/30/2014	637.6	2.20	6.54	-4.34	1.0
				4/1/2015	820.4	3.37	5.93	-2.56	1.0
				6/12/2015	892.4	7.36	5.68	1.68	1.0
				10/2/2015	1004.5	6.50	5.21	1.29	1.0
				3/16/2016	1170.4	6.90	4.67	2.23	1.0
				9/30/2016	1368.6	6.88	3.62	3.26	1.0
				3/31/2017	1550.0	7.56	1.07	6.49	1.0
C11-AI	491,844	1,542,376	1	3/8/2013	66.4	7.46	7.50	-0.04	1.0
				4/2/2014	456.5	8.02	7.07	0.95	1.0
				9/30/2014	637.5	0.80	6.61	-5.81	1.0
				4/1/2015	820.5	2.95	6.13	-3.18	1.0
				6/12/2015	892.4	7.49	5.88	1.61	1.0
				10/2/2015	1004.5	3.02	5.39	-2.37	1.0
				9/30/2016	1368.6	5.00	3.82	1.18	1.0
				3/31/2017	1550.0	8.11	0.97	7.14	1.0
				9/20/2017	1723.0	6.54	0.29	6.25	1.0
C12-AI	492,029	1,542,375	1	3/8/2013	66.4	6.46	5.97	0.49	1.0
				11/1/2013	304.5	3.80	6.06	-2.26	1.0
				3/27/2014	450.5	8.96	5.82	3.14	1.0
				4/1/2015	820.4	3.17	4.24	-1.07	1.0
				6/12/2015	892.4	7.37	4.01	3.36	1.0

Table D-1. Groundwater Transport Model Uranium Calibration Data

Well ID	Easting	Northing	Model Layer	Date	Model Time (days)	Measured Uranium Concentration (mg/L)	Simulated Uranium Concentration (mg/L)	Residual (mg/L)	Weight
				10/2/2015	1004.5	2.31	3.65	-1.34	1.0
				3/16/2016	1170.4	3.48	3.16	0.32	1.0
				9/30/2016	1368.6	2.36	2.50	-0.14	1.0
				3/31/2017	1550.0	3.29	0.66	2.63	1.0
				9/20/2017	1723.0	5.71	0.21	5.50	1.0
C6-AI	491,142	1,541,533	1	3/8/2013	66.4	0.88	1.02	-0.14	1.0
				11/1/2013	304.4	3.10	1.12	1.98	1.0
				3/27/2014	450.6	1.06	1.10	-0.04	1.0
				9/30/2014	637.5	0.71	1.00	-0.29	1.0
				4/1/2015	820.4	0.81	1.00	-0.19	1.0
				6/12/2015	892.4	0.63	1.09	-0.46	1.0
				10/2/2015	1004.5	0.53	1.23	-0.70	1.0
				3/16/2016	1170.4	1.04	1.28	-0.24	1.0
				3/21/2017	1540.0	0.70	0.88	-0.18	1.0
				3/31/2017	1550.0	0.81	0.87	-0.06	1.0
C7-AI	491,280	1,541,734	1	9/20/2017	1723.0	2.07	0.78	1.29	1.0
				4/2/2014	456.6	8.00	8.41	-0.41	1.0
				9/30/2014	637.5	12.3	7.06	5.24	1.0
				4/1/2015	820.4	7.74	6.26	1.48	1.0
				6/12/2015	892.4	9.26	6.31	2.95	1.0
				10/2/2015	1004.5	8.53	6.32	2.21	1.0
				3/16/2016	1170.4	7.06	5.85	1.21	1.0
C8-AI	491,415	1,541,906	1	3/31/2017	1550.0	3.50	3.01	0.49	1.0
				3/8/2013	66.4	11.0	9.78	1.22	1.0
				10/31/2013	303.5	6.80	8.96	-2.16	1.0
				3/27/2014	450.6	12.1	8.35	3.75	1.0
				9/30/2014	637.5	0.80	7.68	-6.88	1.0
				4/1/2015	820.4	9.22	7.20	2.02	1.0
				6/12/2015	892.4	1.89	6.96	-5.07	1.0
				10/2/2015	1004.5	0.88	6.54	-5.66	1.0
				3/16/2016	1170.4	3.40	5.88	-2.48	1.0
				9/30/2016	1368.6	0.50	4.58	-4.08	1.0
C9-AI	491,545	1,542,075	1	3/31/2017	1550.0	3.51	3.22	0.29	1.0
				3/8/2013	66.4	6.79	8.87	-2.08	1.0

Table D-1. Groundwater Transport Model Uranium Calibration Data

Well ID	Easting	Northing	Model Layer	Date	Model Time (days)	Measured Uranium Concentration (mg/L)	Simulated Uranium Concentration (mg/L)	Residual (mg/L)	Weight
				11/1/2013	304.4	5.90	8.43	-2.53	1.0
				3/27/2014	450.6	6.56	7.75	-1.19	1.0
				9/30/2014	637.6	10.00	7.03	2.97	1.0
				4/1/2015	820.4	8.36	6.56	1.80	1.0
				6/12/2015	892.4	9.18	6.34	2.84	1.0
				10/2/2015	1004.5	10.1	5.91	4.19	1.0
				3/16/2016	1170.4	7.70	5.34	2.36	1.0
				3/31/2017	1550.0	5.70	2.45	3.25	1.0
				9/20/2017	1723.0	3.85	1.61	2.24	1.0
CW44-AI	488,891	1,535,048	1	11/15/2013	318.6	0.32	0.38	-0.06	1.0
				6/12/2014	527.5	0.30	0.35	-0.05	1.0
				9/10/2014	617.7	0.26	0.34	-0.07	1.0
				7/30/2015	940.4	0.25	0.28	-0.03	1.0
				7/6/2016	1282.6	0.27	0.26	0.01	1.0
				12/2/2016	1431.6	0.22	0.24	-0.02	1.0
D1-AI	489,615	1,542,140	1	3/5/2013	63.5	2.15	2.52	-0.37	1.0
				3/5/2013	63.5	2.21	2.52	-0.31	1.0
				7/9/2013	189.5	2.29	2.25	0.04	1.0
				3/19/2014	442.6	4.00	1.76	2.24	1.0
				7/11/2014	556.5	3.60	1.65	1.95	1.0
				7/24/2014	569.4	3.57	1.63	1.94	1.0
				3/18/2015	806.5	6.41	1.48	4.93	1.0
				7/16/2015	926.6	7.32	1.62	5.70	1.0
				3/16/2016	1170.4	4.00	1.54	2.46	1.0
				7/12/2016	1288.4	1.38	1.07	0.31	1.0
				3/20/2017	1539.0	0.69	0.49	0.20	1.0
				6/28/2017	1639.0	0.91	0.44	0.47	1.0
D2-AI	492,107	1,542,641	1	6/19/2014	534.4	36.9	4.77	32.1	1.0
DA3-AI	489,390	1,542,664	1	6/12/2015	892.6	15.7	11.2	4.47	1.0
				5/2/2017	1582.0	10.7	2.60	8.10	1.0
DC-AI	487,060	1,543,646	1	6/10/2015	890.5	0.09	0.14	-0.05	1.0
				6/27/2017	1638.0	0.08	0.15	-0.07	1.0
DD2-AI	489,251	1,547,439	1	2/12/2013	42.4	0.23	0.19	0.04	1.0
				5/2/2013	121.6	0.25	0.19	-0.06	1.0

Table D-1. Groundwater Transport Model Uranium Calibration Data

Well ID	Easting	Northing	Model Layer	Date	Model Time (days)	Measured Uranium Concentration (mg/L)	Simulated Uranium Concentration (mg/L)	Residual (mg/L)	Weight
				10/31/2013	303.6	0.23	0.18	0.05	1.0
				11/23/2013	326.4	0.20	0.18	0.02	1.0
				2/19/2014	414.6	0.23	0.18	0.04	1.0
				5/15/2014	499.6	0.23	0.18	0.05	1.0
				8/6/2014	582.4	0.21	0.18	0.03	1.0
				12/12/2014	710.4	0.19	0.18	0.02	1.0
				2/5/2015	765.6	0.23	0.17	0.05	1.0
				5/1/2015	850.6	0.23	0.17	0.05	1.0
				8/6/2015	947.4	0.22	0.17	0.05	1.0
				10/9/2015	1011.5	0.19	0.17	0.02	1.0
				2/10/2016	1135.4	0.22	0.17	0.05	1.0
				5/18/2016	1233.4	0.23	0.17	0.07	1.0
				10/8/2016	1376.5	0.20	0.17	0.03	1.0
				3/1/2017	1520.0	0.20	0.17	0.03	1.0
				5/2/2017	1582.0	0.24	0.16	0.07	1.0
				8/8/2017	1680.0	0.22	0.16	0.06	1.0
				10/12/2017	1745.0	0.22	0.16	0.06	1.0
				11/2/2017	1766.0	0.22	0.16	0.05	1.0
				11/23/2017	1787.0	0.21	0.16	0.05	1.0
DD-AI	488,943	1,546,989	1	2/12/2013	42.5	0.14	0.13	0.01	1.0
				5/2/2013	121.5	0.16	0.13	0.03	1.0
				10/31/2013	303.6	0.16	0.13	0.03	1.0
				11/23/2013	326.4	0.14	0.13	0.01	1.0
				2/12/2014	407.3	0.14	0.13	0.02	1.0
				5/15/2014	499.6	0.16	0.13	0.03	1.0
				8/6/2014	582.4	0.14	0.12	0.01	1.0
				12/12/2014	710.5	0.13	0.12	0.01	1.0
				2/5/2015	765.6	0.14	0.12	0.02	1.0
				5/1/2015	850.5	0.15	0.12	0.03	1.0
				8/6/2015	947.5	0.15	0.12	0.03	1.0
				10/9/2015	1011.5	0.11	0.11	-0.01	1.0
				2/10/2016	1135.4	0.14	0.11	0.02	1.0
				5/18/2016	1233.4	0.14	0.11	0.03	1.0
				10/7/2016	1375.7	0.08	0.11	-0.03	1.0

Table D-1. Groundwater Transport Model Uranium Calibration Data

Well ID	Easting	Northing	Model Layer	Date	Model Time (days)	Measured Uranium Concentration (mg/L)	Simulated Uranium Concentration (mg/L)	Residual (mg/L)	Weight
				3/1/2017	1520.0	0.10	0.11	-0.01	1.0
				5/3/2017	1583.0	0.14	0.12	0.02	1.0
				8/8/2017	1680.0	0.10	0.12	-0.02	1.0
				10/12/2017	1745.0	0.11	0.12	0.00	1.0
				11/23/2017	1787.0	0.10	0.12	-0.02	1.0
DQ-AI	491,005	1,542,591	1	6/12/2015	892.6	0.45	13.2	-12.8	1.0
DR-AI	489,966	1,542,884	1	6/12/2015	892.6	17.2	13.7	3.51	1.0
DT-AI	489,293	1,542,871	1	6/12/2015	892.6	4.78	11.3	-6.56	1.0
DZ-AI	491,501	1,542,834	1	6/10/2015	890.4	40.9	6.55	34.4	1.0
				6/27/2017	1638.0	49.6	5.92	43.7	1.0
F-AI	489,554	1,539,908	1	3/6/2013	64.5	0.05	0.05	0.00	1.0
				10/30/2013	302.5	0.05	0.05	0.00	1.0
				3/19/2014	442.6	0.06	0.05	0.01	1.0
				9/16/2014	623.6	0.05	0.05	0.00	1.0
				3/18/2015	806.6	0.05	0.05	0.00	1.0
				9/26/2015	998.5	0.05	0.05	0.00	1.0
				9/26/2015	998.5	0.05	0.05	0.00	1.0
				3/16/2016	1170.6	0.05	0.05	0.00	1.0
				9/20/2016	1358.6	0.04	0.05	-0.01	1.0
				3/17/2017	1536.0	0.04	0.05	0.00	1.0
				11/14/2017	1778.0	0.05	0.05	0.00	1.0
FB-AI	488,857	1,540,417	1	3/6/2013	64.4	0.07	0.06	0.01	1.0
				11/2/2013	305.4	0.06	0.05	0.01	1.0
				3/20/2014	443.6	0.06	0.05	0.01	1.0
				9/16/2014	623.6	0.06	0.05	0.01	1.0
				3/18/2015	806.6	0.05	0.05	0.00	1.0
				8/7/2015	948.5	0.05	0.04	0.01	1.0
				9/26/2015	998.4	0.05	0.04	0.01	1.0
				3/16/2016	1170.6	0.05	0.04	0.01	1.0
				9/20/2016	1358.6	0.05	0.04	0.00	1.0
				3/17/2017	1536.0	0.04	0.04	-0.01	1.0
				11/14/2017	1778.0	0.04	0.04	0.00	1.0
GH-AI	489,509	1,538,807	1	3/6/2013	64.4	0.11	0.09	0.02	1.0
				11/2/2013	305.5	0.10	0.08	0.02	1.0

Table D-1. Groundwater Transport Model Uranium Calibration Data

Well ID	Easting	Northing	Model Layer	Date	Model Time (days)	Measured Uranium Concentration (mg/L)	Simulated Uranium Concentration (mg/L)	Residual (mg/L)	Weight
				3/19/2014	442.6	0.10	0.08	0.02	1.0
				9/19/2014	626.6	0.09	0.08	0.01	1.0
				3/13/2015	801.5	0.09	0.08	0.01	1.0
				8/7/2015	948.6	0.08	0.08	0.01	1.0
				3/16/2016	1170.5	0.08	0.07	0.01	1.0
				9/20/2016	1358.6	0.07	0.07	0.00	1.0
				3/17/2017	1536.0	0.06	0.07	-0.01	1.0
				11/14/2017	1778.0	0.06	0.07	-0.01	1.0
GN-AI	490,944	1,538,602	1	3/6/2013	64.6	0.08	0.07	0.01	1.0
				3/11/2015	799.6	0.08	0.06	0.02	1.0
				8/19/2015	960.5	0.08	0.06	0.02	1.0
				3/16/2016	1170.6	0.09	0.06	0.03	1.0
				3/20/2017	1539.0	0.05	0.06	-0.01	1.0
				8/14/2017	1686.0	0.04	0.06	-0.02	1.0
GV-AI	491,428	1,537,701	1	10/2/2015	1004.6	0.24	0.05	0.18	1.0
				12/22/2016	1451.4	0.18	0.05	0.13	1.0
				9/20/2017	1723.0	0.15	0.05	0.10	1.0
K10-AI	491,638	1,541,305	1	1/16/2013	15.4	0.68	0.67	0.01	1.0
				11/1/2013	304.6	0.80	0.84	-0.04	1.0
				1/28/2014	392.5	0.77	0.80	-0.03	1.0
				9/18/2014	625.4	0.65	0.60	0.05	1.0
				2/5/2015	765.5	2.30	0.60	1.70	1.0
				6/12/2015	892.4	1.46	0.70	0.76	1.0
				7/17/2015	927.4	2.27	0.72	1.55	1.0
				1/19/2016	1113.5	1.34	0.77	0.57	1.0
				1/6/2017	1466.0	2.24	0.54	1.70	1.0
				3/31/2017	1550.0	0.67	0.47	0.20	1.0
K11-AI	491,490	1,541,325	1	11/7/2017	1771.0	1.01	0.36	0.65	1.0
				1/16/2013	15.5	0.61	0.60	0.01	1.0
				11/1/2013	304.6	0.61	0.80	-0.20	1.0
				1/28/2014	392.6	0.57	0.83	-0.26	1.0
				9/18/2014	625.5	0.52	0.64	-0.12	1.0
				6/12/2015	892.4	0.61	0.72	-0.11	1.0
				7/17/2015	927.4	0.60	0.75	-0.15	1.0

Table D-1. Groundwater Transport Model Uranium Calibration Data

Well ID	Easting	Northing	Model Layer	Date	Model Time (days)	Measured Uranium Concentration (mg/L)	Simulated Uranium Concentration (mg/L)	Residual (mg/L)	Weight
				1/19/2016	1113.5	0.54	0.89	-0.35	1.0
				1/6/2017	1466.0	0.56	0.63	-0.07	1.0
				3/31/2017	1550.0	0.70	0.53	0.17	1.0
				7/18/2017	1659.0	1.01	0.45	0.56	1.0
				11/7/2017	1771.0	1.70	0.41	1.29	1.0
K2-AI	491,587	1,540,736	1	11/7/2013	310.4	0.04	0.05	0.00	1.0
K4-AI	492,371	1,541,211	1	1/16/2013	15.4	0.76	0.44	0.32	1.0
				1/28/2014	392.5	0.23	0.15	0.07	1.0
				9/18/2014	625.6	0.67	0.11	0.55	1.0
				2/5/2015	765.5	0.78	0.10	0.68	1.0
				6/12/2015	892.4	0.66	0.09	0.57	1.0
				7/17/2015	927.4	0.43	0.09	0.35	1.0
				1/21/2016	1115.6	0.21	0.07	0.14	1.0
				7/19/2016	1295.5	0.49	0.05	0.45	1.0
				1/6/2017	1466.0	0.65	0.04	0.61	1.0
				3/31/2017	1550.0	0.64	0.04	0.60	1.0
				7/18/2017	1659.0	0.89	0.04	0.85	1.0
				11/6/2017	1770.0	0.64	0.03	0.61	1.0
K5-AI	491,935	1,541,269	1	1/16/2013	15.4	0.50	0.70	-0.20	1.0
				11/1/2013	304.6	0.61	0.68	-0.07	1.0
				1/28/2014	392.5	0.59	0.65	-0.06	1.0
				9/18/2014	625.4	0.77	0.55	0.22	1.0
				6/12/2015	892.4	0.58	0.52	0.06	1.0
				7/17/2015	927.4	0.59	0.52	0.07	1.0
				1/19/2016	1113.5	0.81	0.49	0.32	1.0
				7/19/2016	1295.6	2.55	0.40	2.15	1.0
				1/6/2017	1466.0	0.62	0.30	0.32	1.0
				3/31/2017	1550.0	0.69	0.26	0.42	1.0
				7/18/2017	1659.0	1.06	0.22	0.84	1.0
				11/7/2017	1771.0	1.35	0.20	1.15	1.0
K7-AI	492,237	1,541,232	1	1/16/2013	15.4	0.52	0.45	0.06	1.0
				11/1/2013	304.6	0.49	0.37	0.12	1.0
				1/28/2014	392.5	0.47	0.32	0.15	1.0
				9/18/2014	625.4	0.39	0.24	0.15	1.0

Table D-1. Groundwater Transport Model Uranium Calibration Data

Well ID	Easting	Northing	Model Layer	Date	Model Time (days)	Measured Uranium Concentration (mg/L)	Simulated Uranium Concentration (mg/L)	Residual (mg/L)	Weight
				2/5/2015	765.5	0.42	0.20	0.22	1.0
				6/12/2015	892.4	0.36	0.17	0.18	1.0
				7/17/2015	927.4	0.41	0.17	0.25	1.0
				1/19/2016	1113.4	0.48	0.13	0.35	1.0
				7/19/2016	1295.5	0.31	0.07	0.23	1.0
				1/6/2017	1466.0	1.35	0.05	1.30	1.0
				3/31/2017	1550.0	0.65	0.05	0.61	1.0
				7/18/2017	1659.0	0.59	0.05	0.54	1.0
				11/6/2017	1770.0	0.39	0.04	0.35	1.0
K8-AI	492,081	1,541,250	1	1/16/2013	15.4	0.69	0.62	0.08	1.0
				11/1/2013	304.6	0.77	0.54	0.24	1.0
				1/28/2014	392.5	0.42	0.50	-0.08	1.0
				9/18/2014	625.4	0.73	0.41	0.32	1.0
				6/12/2015	892.4	0.58	0.36	0.22	1.0
				7/17/2015	927.4	0.56	0.35	0.21	1.0
				1/22/2016	1116.6	0.42	0.29	0.13	1.0
				7/19/2016	1295.5	0.53	0.21	0.32	1.0
				1/6/2017	1466.0	0.92	0.15	0.77	1.0
				3/31/2017	1550.0	0.79	0.13	0.66	1.0
				7/18/2017	1659.0	1.12	0.11	1.01	1.0
				11/6/2017	1770.0	1.08	0.10	0.98	1.0
K9-AI	491,787	1,541,287	1	1/16/2013	15.4	1.07	0.81	0.26	1.0
				11/1/2013	304.6	1.06	0.75	0.31	1.0
				1/28/2014	392.5	0.99	0.72	0.28	1.0
				9/18/2014	625.4	1.27	0.59	0.68	1.0
				2/5/2015	765.5	0.96	0.57	0.39	1.0
				6/12/2015	892.4	0.83	0.60	0.23	1.0
				7/17/2015	927.4	1.19	0.61	0.58	1.0
				1/19/2016	1113.5	1.55	0.62	0.93	1.0
				7/19/2016	1295.6	0.65	0.55	0.10	1.0
				1/6/2017	1466.0	0.61	0.45	0.16	1.0
				3/31/2017	1550.0	0.69	0.39	0.30	1.0
				11/7/2017	1771.0	1.00	0.30	0.70	1.0
KEB-AI	491,487	1,540,570	1	2/28/2013	58.4	0.07	0.06	0.01	1.0

Table D-1. Groundwater Transport Model Uranium Calibration Data

Well ID	Easting	Northing	Model Layer	Date	Model Time (days)	Measured Uranium Concentration (mg/L)	Simulated Uranium Concentration (mg/L)	Residual (mg/L)	Weight
KF-AI	491,169	1,540,870	1	2/28/2013	58.5	0.08	0.08	0.01	1.0
				7/22/2015	932.5	0.04	0.04	0.00	1.0
				3/28/2017	1547.0	0.04	0.03	0.02	1.0
KZ-AI	491,183	1,541,100	1	2/28/2013	58.5	0.08	0.10	-0.02	1.0
				3/28/2017	1547.0	0.07	0.06	0.01	1.0
L10-AI	492,310	1,539,250	1	5/14/2013	133.4	0.32	0.28	0.04	1.0
				5/30/2014	514.4	0.32	0.22	0.09	1.0
				12/24/2014	722.4	0.30	0.20	0.10	1.0
				4/3/2015	822.4	0.35	0.08	0.28	1.0
				10/17/2015	1019.4	0.24	0.05	0.19	1.0
				4/13/2016	1198.4	0.27	0.05	0.22	1.0
				10/27/2016	1395.6	0.24	0.05	0.19	1.0
				5/1/2017	1581.0	0.37	0.05	0.32	1.0
L5-AI	492,730	1,539,946	1	10/23/2017	1756.0	0.31	0.05	0.25	1.0
				5/14/2013	133.4	0.28	0.24	0.05	1.0
				5/30/2014	514.5	0.22	0.20	0.02	1.0
				12/24/2014	722.4	0.23	0.18	0.04	1.0
				4/3/2015	822.4	0.28	0.11	0.16	1.0
				11/19/2015	1052.4	0.22	0.10	0.13	1.0
				4/13/2016	1198.5	0.17	0.10	0.08	1.0
				5/1/2017	1581.0	0.21	0.10	0.11	1.0
L6-AI	493,110	1,540,526	1	10/23/2017	1756.0	0.18	0.10	0.09	1.0
				5/14/2013	133.4	0.26	0.27	0.00	1.0
				5/30/2014	514.6	0.29	0.25	0.04	1.0
				12/24/2014	722.5	0.24	0.24	0.00	1.0
				4/3/2015	822.5	0.27	0.24	0.03	1.0
				10/17/2015	1019.4	0.21	0.23	-0.03	1.0
				4/13/2016	1198.5	0.23	0.23	0.00	1.0
				10/27/2016	1395.6	0.23	0.23	0.00	1.0
L7-AI	492,842	1,540,113	1	5/1/2017	1581.0	0.26	0.23	0.03	1.0
				10/23/2017	1756.0	0.25	0.23	0.02	1.0
				5/14/2013	133.4	0.21	0.23	-0.01	1.0
				5/30/2014	514.5	0.25	0.19	0.06	1.0
				12/24/2014	722.4	0.25	0.17	0.07	1.0

Table D-1. Groundwater Transport Model Uranium Calibration Data

Well ID	Easting	Northing	Model Layer	Date	Model Time (days)	Measured Uranium Concentration (mg/L)	Simulated Uranium Concentration (mg/L)	Residual (mg/L)	Weight
				4/3/2015	822.4	0.29	0.06	0.23	1.0
				11/19/2015	1052.4	0.26	0.03	0.23	1.0
				4/13/2016	1198.5	0.26	0.03	0.23	1.0
				5/1/2017	1581.0	0.27	0.04	0.23	1.0
				10/23/2017	1756.0	0.20	0.04	0.16	1.0
L8-AI	492,621	1,539,773	1	5/14/2013	133.4	0.19	0.21	-0.02	1.0
				12/24/2014	722.4	0.17	0.16	0.02	1.0
				4/3/2015	822.4	0.19	0.06	0.13	1.0
				10/17/2015	1019.4	0.22	0.04	0.18	1.0
				4/13/2016	1198.5	0.22	0.03	0.19	1.0
				10/27/2016	1395.6	0.40	0.04	0.37	1.0
				5/1/2017	1581.0	0.30	0.04	0.26	1.0
L9-AI	492,463	1,539,509	1	5/16/2013	135.6	0.29	0.27	0.02	1.0
				5/30/2014	514.5	0.24	0.23	0.01	1.0
				12/24/2014	722.4	0.28	0.21	0.07	1.0
				4/3/2015	822.4	0.28	0.19	0.09	1.0
				11/19/2015	1052.4	0.20	0.17	0.03	1.0
				4/13/2016	1198.4	0.21	0.13	0.08	1.0
				5/1/2017	1581.0	0.25	0.13	0.11	1.0
				10/23/2017	1756.0	0.24	0.14	0.10	1.0
L-AI	492,150	1,538,970	1	5/14/2013	133.3	0.51	0.40	0.11	1.0
				5/30/2014	514.4	0.48	0.31	0.17	1.0
				12/24/2014	722.4	0.45	0.28	0.17	1.0
				4/3/2015	822.4	0.50	0.19	0.31	1.0
				10/27/2016	1395.6	0.38	0.18	0.19	1.0
				5/1/2017	1581.0	0.51	0.19	0.32	1.0
				10/23/2017	1756.0	0.39	0.19	0.20	1.0
M10-AI	486,723	1,543,677	1	5/15/2013	134.6	0.17	0.19	-0.02	1.0
				3/17/2016	1171.6	0.15	0.15	-0.01	1.0
				3/24/2017	1543.0	0.14	0.15	-0.01	1.0
M16-AI	485,112	1,543,252	1	10/2/2015	1004.6	0.67	0.17	0.50	1.0
				9/19/2017	1722.0	0.54	0.34	0.20	1.0
M3-AI	489,151	1,542,805	1	11/24/2013	327.5	11.2	9.22	1.98	1.0
				6/12/2015	892.6	8.80	7.53	1.27	1.0

Table D-1. Groundwater Transport Model Uranium Calibration Data

Well ID	Easting	Northing	Model Layer	Date	Model Time (days)	Measured Uranium Concentration (mg/L)	Simulated Uranium Concentration (mg/L)	Residual (mg/L)	Weight
				3/23/2017	1542.0	2.90	2.72	0.18	1.0
M5-AI	489,080	1,542,360	1	12/4/2013	337.4	0.18	0.22	-0.05	1.0
				7/29/2015	939.5	0.22	0.23	-0.01	1.0
M6-AI	486,674	1,543,097	1	5/15/2013	134.5	1.85	1.79	0.06	1.0
				3/4/2015	792.4	2.27	1.12	1.15	1.0
				3/24/2017	1543.0	1.74	0.96	0.78	1.0
M7-AI	486,523	1,542,790	1	3/21/2013	79.4	1.69	1.19	0.50	1.0
				3/4/2015	792.5	1.24	0.84	0.40	1.0
				3/17/2016	1171.6	0.99	0.75	0.24	1.0
M9-AI	486,699	1,543,310	1	2/21/2013	51.6	1.35	1.59	-0.24	1.0
				11/24/2013	327.4	5.12	1.68	3.44	1.0
				12/18/2013	351.5	2.29	1.68	0.61	1.0
				9/30/2014	637.6	3.60	1.76	1.84	1.0
				3/4/2015	792.5	1.19	1.78	-0.59	1.0
				6/12/2015	892.6	1.66	1.75	-0.09	1.0
				10/2/2015	1004.6	2.63	1.69	0.94	1.0
				3/17/2016	1171.5	1.08	1.55	-0.47	1.0
ML-AI	486,691	1,543,902	1	5/15/2013	134.6	0.11	0.11	0.00	1.0
				3/17/2016	1171.6	0.10	0.11	-0.02	1.0
				3/24/2017	1543.0	0.10	0.11	-0.01	1.0
MO-AI	485,518	1,543,620	1	3/5/2013	63.5	0.27	0.14	0.12	1.0
				11/2/2013	305.4	0.26	0.04	0.22	1.0
				3/20/2014	443.4	0.24	0.03	0.21	1.0
				3/13/2015	801.4	0.25	0.09	0.17	1.0
				10/16/2015	1018.6	0.27	0.13	0.13	1.0
				3/16/2016	1170.4	0.28	0.15	0.12	1.0
				10/27/2016	1395.4	0.24	0.17	0.07	1.0
				3/17/2017	1536.0	0.19	0.17	0.02	1.0
MQ-AI	486,326	1,543,173	1	2/21/2013	51.5	0.96	0.93	0.03	1.0
				11/24/2013	327.4	1.37	0.98	0.39	1.0
				9/30/2014	637.6	0.94	1.18	-0.25	1.0
				3/4/2015	792.5	0.82	1.27	-0.45	1.0
				6/12/2015	892.6	0.87	1.31	-0.44	1.0
				10/2/2015	1004.6	0.88	1.30	-0.41	1.0

Table D-1. Groundwater Transport Model Uranium Calibration Data

Well ID	Easting	Northing	Model Layer	Date	Model Time (days)	Measured Uranium Concentration (mg/L)	Simulated Uranium Concentration (mg/L)	Residual (mg/L)	Weight
				3/17/2016	1171.5	0.75	1.29	-0.54	1.0
				3/24/2017	1543.0	0.73	1.26	-0.53	1.0
				9/19/2017	1722.0	0.80	1.24	-0.44	1.0
MR-AI	483,574	1,542,609	1	3/11/2015	799.5	0.39	0.42	-0.03	1.0
				4/15/2015	834.4	0.41	0.42	-0.01	1.0
				8/8/2015	949.6	0.43	0.41	0.02	1.0
				3/16/2016	1170.4	0.50	0.41	0.10	1.0
				9/9/2016	1347.6	0.43	0.40	0.03	1.0
				3/20/2017	1539.0	0.39	0.40	-0.01	1.0
				5/1/2017	1581.0	0.46	0.40	0.06	1.0
				8/11/2017	1683.0	0.46	0.39	0.07	1.0
				10/13/2017	1746.0	0.48	0.39	0.08	1.0
MS-AI	485,570	1,542,607	1	5/1/2013	120.7	0.43	0.32	0.12	1.0
				11/24/2013	327.5	0.06	0.29	-0.23	1.0
				7/1/2016	1277.6	0.18	0.13	0.04	1.0
				3/29/2017	1548.0	0.16	0.11	0.05	1.0
				7/19/2017	1660.0	0.15	0.11	0.04	1.0
				12/1/2017	1795.0	0.15	0.10	0.05	1.0
MT-AI	483,531	1,543,221	1	5/16/2013	135.6	0.04	0.05	-0.01	1.0
MV-AI	484,418	1,542,618	1	5/16/2013	135.4	0.54	0.51	0.03	1.0
				3/25/2015	813.5	0.41	0.50	-0.09	1.0
MW-AI	486,346	1,543,802	1	5/16/2013	135.4	0.10	0.09	0.01	1.0
				3/24/2017	1543.0	0.09	0.10	-0.01	1.0
MX-AI	486,244	1,541,287	1	5/15/2013	134.6	0.03	0.04	0.00	1.0
				3/11/2015	799.5	0.03	0.04	-0.01	1.0
				8/19/2015	960.4	0.04	0.04	0.00	1.0
				3/16/2016	1170.4	0.05	0.04	0.01	1.0
				3/20/2017	1539.0	0.03	0.04	-0.01	1.0
				8/11/2017	1683.0	0.05	0.04	0.01	1.0
				11/13/2017	1777.0	0.03	0.04	-0.01	1.0
MY-AI	486,213	1,542,200	1	12/17/2016	1446.4	0.04	0.05	0.00	1.0
				11/13/2017	1777.0	0.04	0.06	-0.02	1.0
MZ-AI	486,757	1,543,485	1	5/16/2013	135.4	0.24	0.41	-0.17	1.0
				3/4/2015	792.4	0.14	0.48	-0.34	1.0

Table D-1. Groundwater Transport Model Uranium Calibration Data

Well ID	Easting	Northing	Model Layer	Date	Model Time (days)	Measured Uranium Concentration (mg/L)	Simulated Uranium Concentration (mg/L)	Residual (mg/L)	Weight
				3/17/2016	1171.6	0.12	0.48	-0.36	1.0
				3/24/2017	1543.0	0.12	0.43	-0.31	1.0
NB-AI	491,296	1,545,000	1	8/28/2015	969.6	26.1	11.2	14.9	1.0
				8/21/2017	1693.0	33.9	9.43	24.5	1.0
NC-AI	491,282	1,545,220	1	4/15/2015	834.5	0.01	3.23	-3.22	1.0
				8/27/2015	968.6	0.23	4.04	-3.81	1.0
				8/16/2017	1688.0	0.14	3.90	-3.75	1.0
ND-AI	494,872	1,545,927	1	12/4/2013	337.4	0.02	0.02	0.00	1.0
				3/27/2015	815.6	0.03	0.02	0.00	1.0
				5/13/2015	862.4	0.04	0.02	0.02	1.0
O-AI	492,725	1,545,060	1	8/27/2015	968.6	0.04	5.72	-5.68	1.0
				8/17/2017	1689.0	0.03	6.82	-6.79	1.0
P2-AI	490,912	1,546,555	1	2/21/2013	51.6	0.04	0.04	0.00	1.0
				4/1/2015	820.4	0.03	0.03	-0.01	1.0
				3/23/2017	1542.0	0.03	0.03	0.00	1.0
P3-AI	490,785	1,546,159	1	2/21/2013	51.6	0.03	0.03	0.00	1.0
				4/1/2015	820.4	0.02	0.03	-0.01	1.0
				3/23/2017	1542.0	0.02	0.03	-0.01	1.0
P4-AI	491,899	1,546,504	1	2/21/2013	51.6	0.03	0.03	0.00	1.0
				10/4/2014	641.3	0.02	0.03	-0.01	1.0
				4/1/2015	820.4	0.01	0.03	-0.01	1.0
				3/23/2017	1542.0	0.02	0.03	-0.01	1.0
P-AI	491,058	1,546,691	1	5/8/2013	127.5	0.04	0.04	0.00	1.0
				11/6/2013	309.4	0.03	0.04	0.00	1.0
				5/15/2014	499.6	0.03	0.03	0.00	1.0
				5/20/2015	869.4	0.03	0.03	-0.01	1.0
				10/21/2015	1023.5	0.04	0.03	0.01	1.0
				5/17/2016	1232.4	0.03	0.03	0.00	1.0
				9/14/2017	1717.0	0.03	0.03	-0.01	1.0
				10/26/2017	1759.0	0.03	0.03	-0.01	1.0
Q-AI	492,153	1,548,693	1	5/14/2013	133.6	0.06	0.05	0.00	1.0
				3/27/2015	815.7	0.05	0.05	0.00	1.0
				5/1/2015	850.6	0.05	0.05	0.00	1.0
				5/18/2016	1233.5	0.05	0.05	0.00	1.0

Table D-1. Groundwater Transport Model Uranium Calibration Data

Well ID	Easting	Northing	Model Layer	Date	Model Time (days)	Measured Uranium Concentration (mg/L)	Simulated Uranium Concentration (mg/L)	Residual (mg/L)	Weight
				10/7/2016	1375.4	0.05	0.05	0.00	1.0
				10/27/2016	1395.5	0.06	0.05	0.01	1.0
				3/23/2017	1542.0	0.05	0.05	0.00	1.0
				5/3/2017	1583.0	0.05	0.05	0.00	1.0
				6/1/2017	1612.0	0.05	0.05	0.00	1.0
				12/5/2017	1799.0	0.05	0.05	0.00	1.0
R-AI	494,514	1,550,372	1	5/14/2013	133.6	0.02	0.03	-0.01	1.0
				3/27/2015	815.6	0.02	0.03	-0.01	1.0
				5/13/2015	862.4	0.03	0.03	0.00	1.0
				5/18/2016	1233.4	0.02	0.03	-0.01	1.0
				10/27/2016	1395.4	0.02	0.03	-0.01	1.0
				5/3/2017	1583.0	0.02	0.03	-0.01	1.0
S11-AI	488,150	1,544,793	1	12/4/2013	337.4	0.08	0.04	0.04	1.0
				1/16/2017	1476.0	0.02	0.02	-0.01	1.0
				10/13/2017	1746.0	0.01	0.03	-0.01	1.0
S12-AI	488,628	1,543,297	1	1/17/2013	16.4	1.78	0.99	0.79	1.0
				2/11/2014	406.4	1.95	0.76	1.19	1.0
				2/6/2015	766.4	7.30	0.93	6.37	1.0
S1-AI	488,401	1,543,288	1	4/11/2015	830.4	0.35	0.59	-0.24	1.0
				8/27/2015	968.4	0.31	0.63	-0.32	1.0
				10/28/2015	1030.5	0.36	0.65	-0.30	1.0
				1/27/2016	1121.5	0.30	0.68	-0.38	1.0
S2-AI	488,299	1,543,127	1	1/15/2013	14.6	5.07	2.80	2.27	1.0
				7/10/2013	190.4	5.03	2.58	2.45	1.0
				1/22/2014	386.4	4.58	2.31	2.27	1.0
				7/11/2014	556.6	4.21	1.99	2.22	1.0
				1/30/2015	759.5	3.60	1.94	1.66	1.0
				7/17/2015	927.4	3.16	1.93	1.23	1.0
				1/20/2016	1114.4	2.26	1.83	0.43	1.0
				7/10/2016	1286.4	5.20	1.46	3.74	1.0
				1/13/2017	1473.0	3.20	1.02	2.18	1.0
S3-AI	488,714	1,542,857	1	7/18/2017	1659.0	3.40	0.94	2.46	1.0
				4/11/2015	830.5	13.1	1.86	11.2	1.0

Table D-1. Groundwater Transport Model Uranium Calibration Data

Well ID	Easting	Northing	Model Layer	Date	Model Time (days)	Measured Uranium Concentration (mg/L)	Simulated Uranium Concentration (mg/L)	Residual (mg/L)	Weight
				7/30/2015	940.5	14.8	1.91	12.9	1.0
				1/29/2016	1123.5	17.7	1.85	15.9	1.0
				7/19/2017	1660.0	8.48	0.85	7.63	1.0
S4-AI	488,359	1,543,344	1	3/5/2013	63.6	0.32	0.42	-0.10	1.0
				7/10/2013	190.4	0.29	0.42	-0.13	1.0
				3/20/2014	443.5	0.31	0.43	-0.12	1.0
				7/11/2014	556.6	0.29	0.43	-0.14	1.0
				7/23/2014	568.4	0.29	0.43	-0.15	1.0
				7/17/2015	927.5	0.41	0.55	-0.14	1.0
				1/29/2016	1123.6	0.30	0.66	-0.36	1.0
				1/29/2016	1123.6	0.27	0.66	-0.39	1.0
				3/16/2016	1170.4	0.30	0.66	-0.36	1.0
				7/10/2016	1286.4	0.48	0.65	-0.17	1.0
				3/14/2017	1533.0	0.14	0.56	-0.42	1.0
				7/18/2017	1659.0	0.15	0.55	-0.40	1.0
S5R-AI	488,938	1,543,150	1	11/13/2017	1777.0	0.15	0.54	-0.39	1.0
				11/24/2013	327.4	21.6	9.21	12.4	1.0
				6/12/2015	892.6	22.0	8.70	13.3	1.0
SA-AI	488,811	1,543,122	1	3/23/2017	1542.0	0.95	4.64	-3.68	1.0
				4/18/2015	837.7	42.0	6.49	35.5	1.0
				6/12/2015	892.6	45.4	6.65	38.8	1.0
				1/20/2016	1114.4	2.23	6.42	-4.19	1.0
				1/29/2016	1123.6	17.2	6.28	10.9	1.0
				3/22/2017	1541.0	35.8	3.07	32.7	1.0
SB-AI	488,811	1,543,371	1	11/13/2017	1777.0	33.2	2.68	30.5	1.0
				6/12/2015	892.6	46.6	5.28	41.3	1.0
				3/22/2017	1541.0	40.3	2.93	37.4	1.0
SE6-AI	488,615	1,543,244	1	11/9/2017	1773.0	37.8	2.89	34.9	1.0
				1/16/2013	15.7	0.61	1.93	-1.32	1.0
				2/11/2014	406.4	4.44	1.31	3.13	1.0
				1/29/2015	758.5	31.6	1.70	29.9	1.0
				2/6/2015	766.4	27.4	1.71	25.7	1.0
				1/26/2016	1120.5	16.0	1.92	14.1	1.0
				1/29/2016	1123.6	15.4	1.93	13.5	1.0

Table D-1. Groundwater Transport Model Uranium Calibration Data

Well ID	Easting	Northing	Model Layer	Date	Model Time (days)	Measured Uranium Concentration (mg/L)	Simulated Uranium Concentration (mg/L)	Residual (mg/L)	Weight
				1/17/2017	1477.0	45.0	1.78	43.2	1.0
				11/13/2017	1777.0	10.3	1.79	8.51	1.0
SM-AI	488,566	1,543,748	1	5/16/2013	135.6	1.77	2.00	-0.23	1.0
				5/29/2014	513.6	0.83	1.36	-0.53	1.0
				5/20/2015	869.4	0.51	1.30	-0.79	1.0
				5/3/2017	1583.0	9.12	0.47	8.65	1.0
SO-AI	488,381	1,543,652	1	5/29/2014	513.6	4.24	1.25	2.99	1.0
				5/20/2015	869.4	2.90	1.01	1.89	1.0
				5/3/2017	1583.0	2.83	0.37	2.46	1.0
SQ-AI	488,814	1,543,507	1	6/12/2015	892.6	37.3	8.47	28.8	1.0
SS-AI	488,666	1,543,374	1	1/16/2013	15.6	0.56	1.42	-0.86	1.0
ST-AI	488,688	1,543,215	1	1/16/2013	15.6	11.2	5.58	5.62	1.0
				11/24/2013	327.4	13.3	2.11	11.2	1.0
				6/12/2015	892.6	31.6	2.86	28.7	1.0
				1/26/2016	1120.6	1.05	3.24	-2.19	1.0
				1/24/2017	1484.0	0.77	2.45	-1.68	1.0
				3/23/2017	1542.0	0.75	2.39	-1.64	1.0
SUB1-AI	489,100	1,537,620	1	5/1/2013	120.6	0.11	0.09	0.02	1.0
				10/26/2017	1759.0	0.12	0.04	0.07	1.0
SUB2-AI	490,370	1,537,392	1	5/1/2013	120.4	0.04	0.04	0.00	1.0
				11/6/2013	309.4	0.03	0.04	-0.01	1.0
				5/29/2014	513.5	0.03	0.04	-0.01	1.0
				5/13/2015	862.4	0.03	0.04	-0.01	1.0
				10/21/2015	1023.5	0.03	0.04	-0.01	1.0
				10/27/2016	1395.6	0.03	0.04	-0.01	1.0
				6/1/2017	1612.0	0.02	0.04	-0.02	1.0
SUB3-AI	489,420	1,538,280	1	5/1/2013	120.4	0.02	0.03	-0.01	1.0
				11/6/2013	309.6	0.01	0.03	-0.02	1.0
				5/29/2014	513.5	0.01	0.03	-0.02	1.0
				4/15/2015	834.4	0.02	0.04	-0.02	1.0
				11/4/2015	1037.6	0.01	0.04	-0.03	1.0
				6/2/2017	1613.0	0.01	0.05	-0.05	1.0
				10/26/2017	1759.0	0.01	0.05	-0.04	1.0
SV-AI	488,813	1,543,676	1	11/24/2013	327.4	30.8	8.85	22.0	1.0

Table D-1. Groundwater Transport Model Uranium Calibration Data

Well ID	Easting	Northing	Model Layer	Date	Model Time (days)	Measured Uranium Concentration (mg/L)	Simulated Uranium Concentration (mg/L)	Residual (mg/L)	Weight
				6/12/2015	892.6	39.1	9.16	29.9	1.0
				3/22/2017	1541.0	5.69	2.72	2.97	1.0
SW-AI	488,812	1,543,783	1	5/29/2014	513.6	11.8	7.46	4.34	1.0
				5/13/2015	862.6	25.0	8.53	16.5	1.0
				5/3/2017	1583.0	1.41	2.40	-0.99	1.0
SZ-AI	488,833	1,544,367	1	1/17/2013	16.6	54.6	49.1	5.46	1.0
				2/11/2014	406.4	59.0	34.1	24.9	1.0
				2/6/2015	766.5	48.0	29.4	18.6	1.0
				1/29/2016	1123.5	44.0	30.3	13.7	1.0
				1/16/2017	1476.0	8.30	9.97	-1.67	1.0
T10-AI	492,791	1,543,434	1	11/20/2014	688.5	46.0	20.8	25.2	1.0
				7/29/2015	939.5	44.5	17.2	27.3	1.0
				8/3/2017	1675.0	48.5	10.5	38.0	1.0
T11-AI	489,887	1,544,585	1	11/13/2014	681.4	2.83	9.11	-6.28	1.0
				7/28/2015	938.6	8.65	8.56	0.09	1.0
				3/29/2017	1548.0	10.1	9.50	0.60	1.0
T12-AI	490,317	1,544,583	1	5/2/2013	121.4	1.92	3.40	-1.48	1.0
				11/13/2014	681.4	1.49	4.28	-2.79	1.0
				7/28/2015	938.6	1.42	4.72	-3.30	1.0
T14-AI	491,071	1,544,565	1	11/26/2014	694.6	36.3	11.7	24.6	1.0
T15-AI	491,953	1,544,480	1	11/26/2014	694.6	8.61	9.47	-0.86	1.0
				6/10/2015	890.5	11.0	9.38	1.62	1.0
T16-AI	492,718	1,544,276	1	11/26/2014	694.5	51.5	43.3	8.19	1.0
				5/16/2015	865.6	54.0	40.0	14.0	1.0
T17-AI	489,430	1,544,008	1	11/13/2014	681.4	23.0	14.5	8.46	1.0
				5/15/2015	864.6	26.3	14.0	12.3	1.0
T18-AI	490,333	1,543,977	1	11/13/2014	681.4	8.10	8.63	-0.53	1.0
				5/16/2015	865.5	3.60	8.54	-4.94	1.0
T19-AI	490,722	1,543,958	1	11/13/2014	681.5	10.3	9.46	0.84	1.0
				5/16/2015	865.5	2.31	9.35	-7.04	1.0
				11/9/2017	1773.0	12.4	8.70	3.70	1.0
T20-AI	491,048	1,543,935	1	6/24/2015	904.4	3.74	9.14	-5.40	1.0
				12/11/2017	1805.0	9.66	8.34	1.32	1.0
T21-AI	491,882	1,543,951	1	5/2/2013	121.4	7.25	7.72	-0.47	1.0

Table D-1. Groundwater Transport Model Uranium Calibration Data

Well ID	Easting	Northing	Model Layer	Date	Model Time (days)	Measured Uranium Concentration (mg/L)	Simulated Uranium Concentration (mg/L)	Residual (mg/L)	Weight
				11/20/2014	688.5	3.72	7.67	-3.95	1.0
				6/10/2015	890.4	5.47	7.68	-2.21	1.0
				12/11/2017	1805.0	6.43	10.3	-3.91	1.0
T22-AI	492,311	1,543,876	1	11/20/2014	688.5	0.91	17.0	-16.1	1.0
				6/10/2015	890.5	1.00	19.3	-18.3	1.0
				7/29/2015	939.4	1.40	19.9	-18.5	1.0
T23-AI	492,805	1,543,901	1	11/26/2014	694.5	82.2	40.3	41.9	1.0
				6/10/2015	890.6	75.0	34.3	40.7	1.0
T2-AI	489,303	1,543,538	1	11/23/2013	326.5	7.78	10.5	-2.69	1.0
				11/19/2014	687.3	9.30	10.5	-1.19	1.0
				7/28/2015	938.5	12.0	10.0	1.96	1.0
				12/12/2017	1806.0	24.4	10.5	13.9	1.0
T36-AI	489,688	1,543,735	1	5/15/2015	864.5	4.23	9.34	-5.11	1.0
T39-AI	491,669	1,544,498	1	11/26/2014	694.6	6.90	9.17	-2.27	1.0
				6/10/2015	890.4	11.0	8.97	2.03	1.0
T40-AI	491,466	1,543,819	1	6/10/2015	890.6	8.95	8.31	0.64	1.0
				12/12/2017	1806.0	7.87	7.72	0.15	1.0
T41-AI	491,079	1,543,278	1	11/19/2014	687.4	4.03	9.47	-5.44	1.0
				5/15/2015	864.6	5.05	9.36	-4.31	1.0
				12/12/2017	1806.0	6.65	8.59	-1.94	1.0
T4-AI	489,699	1,543,340	1	5/2/2013	121.5	4.00	5.18	-1.18	1.0
				11/19/2014	687.6	2.71	5.92	-3.21	1.0
				7/28/2015	938.6	3.22	6.40	-3.18	1.0
T5-AI	490,289	1,543,307	1	11/19/2014	687.6	11.6	9.52	2.08	1.0
				7/28/2015	938.6	7.72	9.36	-1.64	1.0
T6-AI	490,655	1,543,282	1	5/19/2015	868.6	8.62	9.34	-0.72	1.0
T7-AI	491,484	1,543,272	1	5/19/2015	868.6	29.1	9.31	19.8	1.0
T8-AI	491,914	1,543,296	1	5/15/2015	864.6	17.5	10.3	7.19	1.0
T9-AI	492,337	1,543,347	1	11/20/2014	688.5	27.0	13.9	13.1	1.0
				7/28/2015	938.6	17.0	13.3	3.70	1.0
TA-AI	492,426	1,542,471	1	9/30/2015	1002.6	2.28	1.87	0.41	1.0
				9/30/2016	1368.5	1.44	1.22	0.22	1.0
				9/26/2017	1729.0	3.00	0.66	2.34	1.0
T-AI	492,260	1,542,536	1	3/21/2013	79.4	8.61	7.86	0.75	1.0

Table D-1. Groundwater Transport Model Uranium Calibration Data

Well ID	Easting	Northing	Model Layer	Date	Model Time (days)	Measured Uranium Concentration (mg/L)	Simulated Uranium Concentration (mg/L)	Residual (mg/L)	Weight
				5/16/2015	865.4	4.72	2.81	1.91	1.0
				6/12/2015	892.5	4.42	2.78	1.64	1.0
				9/30/2015	1002.6	6.48	2.72	3.76	1.0
				9/30/2016	1368.5	3.41	2.35	1.06	1.0
				9/26/2017	1729.0	4.83	1.56	3.27	1.0
TB-AI	492,616	1,542,351	1	10/1/2015	1003.6	0.83	0.45	0.38	1.0
				9/26/2017	1729.0	2.34	0.09	2.25	1.0
X-AI	491,892	1,540,512	1	2/12/2013	42.6	0.04	0.06	-0.02	1.0
				4/20/2013	109.6	0.06	0.06	0.00	1.0
				7/9/2013	189.6	0.06	0.06	0.00	1.0
				11/1/2013	304.6	0.06	0.05	0.01	1.0
				2/12/2014	407.5	0.05	0.05	0.00	1.0
				4/22/2014	476.5	0.04	0.04	0.00	1.0
				7/11/2014	556.6	0.07	0.04	0.03	1.0
				7/24/2014	569.4	0.06	0.04	0.02	1.0
				2/4/2015	764.6	0.05	0.04	0.01	1.0
				4/3/2015	822.5	0.04	0.04	0.00	1.0
				7/17/2015	927.4	0.05	0.04	0.01	1.0
				10/9/2015	1011.5	0.06	0.04	0.03	1.0
				2/10/2016	1135.4	0.10	0.03	0.07	1.0
				4/13/2016	1198.4	0.12	0.03	0.08	1.0
				7/10/2016	1286.5	0.06	0.03	0.04	1.0
				10/21/2016	1389.6	0.06	0.02	0.04	1.0
				3/1/2017	1520.0	0.05	0.02	0.03	1.0
				5/1/2017	1581.0	0.06	0.02	0.04	1.0
				7/18/2017	1659.0	0.05	0.02	0.04	1.0
				10/26/2017	1759.0	0.07	0.02	0.05	1.0
				11/28/2017	1792.0	0.04	0.02	0.02	1.0
0494-UC	489,494	1,536,689	4	2/9/2013	39.4	0.12	0.12	0.00	1.0
				7/9/2013	189.4	0.15	0.13	0.02	1.0
				2/13/2014	408.4	0.17	0.17	0.00	1.0
				6/17/2014	532.5	0.17	0.17	0.00	1.0
				3/5/2015	793.5	0.00	0.17	-0.17	1.0
				5/22/2015	871.5	0.14	0.17	-0.03	1.0

Table D-1. Groundwater Transport Model Uranium Calibration Data

Well ID	Easting	Northing	Model Layer	Date	Model Time (days)	Measured Uranium Concentration (mg/L)	Simulated Uranium Concentration (mg/L)	Residual (mg/L)	Weight
				2/16/2016	1141.6	0.20	0.18	0.02	1.0
				7/13/2016	1289.6	0.21	0.18	0.03	1.0
				3/1/2017	1520.0	0.22	0.18	0.04	1.0
				6/28/2017	1639.0	0.19	0.18	0.01	1.0
0929-UC	495,585	1,544,684	4	2/26/2013	56.6	0.04	0.04	0.00	1.0
				10/4/2014	641.4	0.03	0.04	-0.01	1.0
				7/2/2015	912.5	0.03	0.04	-0.01	1.0
0931-UC	495,207	1,542,461	4	10/3/2014	640.6	0.05	0.00	0.05	1.0
				7/2/2015	912.4	0.01	0.00	0.00	1.0
				7/5/2017	1646.0	0.00	0.00	0.00	1.0
AW-UC	488,015	1,540,235	4	12/10/2013	343.6	0.14	0.07	0.07	1.0
				10/11/2014	648.5	0.12	0.06	0.06	1.0
				10/24/2015	1026.6	0.10	0.05	0.04	1.0
				12/20/2016	1449.4	0.07	0.06	0.02	1.0
				11/30/2017	1794.0	0.10	0.06	0.04	1.0
CE10-UC	490,177	1,541,737	4	9/5/2013	247.5	3.18	2.19	0.99	1.0
				7/24/2014	569.5	3.33	2.21	1.12	1.0
				7/17/2015	927.5	4.93	2.19	2.74	1.0
				7/19/2017	1660.0	3.39	1.83	1.56	1.0
CE11-UC	490,494	1,541,486	4	2/26/2013	56.5	2.72	1.73	0.99	1.0
				8/6/2015	947.4	4.91	1.43	3.48	1.0
				7/19/2016	1295.3	3.10	1.26	1.84	1.0
				2/10/2017	1501.0	3.18	1.16	2.02	1.0
				7/19/2017	1660.0	0.25	1.13	-0.88	1.0
CE12-UC	489,642	1,541,867	4	2/26/2013	56.4	2.32	1.35	0.97	1.0
				7/24/2014	569.6	2.47	0.89	1.58	1.0
				9/30/2014	637.5	2.42	0.88	1.54	1.0
				8/6/2015	947.4	6.92	1.03	5.89	1.0
				7/19/2016	1295.3	1.50	0.89	0.61	1.0
				3/21/2017	1540.0	0.88	0.68	0.20	1.0
				7/19/2017	1660.0	1.11	0.67	0.44	1.0
CE13-UC	490,338	1,542,693	4	7/24/2014	569.6	27.9	25.2	2.67	1.0
				10/3/2014	640.4	26.6	24.1	2.52	1.0
				7/17/2015	927.6	28.9	22.3	6.61	1.0

Table D-1. Groundwater Transport Model Uranium Calibration Data

Well ID	Easting	Northing	Model Layer	Date	Model Time (days)	Measured Uranium Concentration (mg/L)	Simulated Uranium Concentration (mg/L)	Residual (mg/L)	Weight
				7/20/2017	1661.0	22.1	19.4	2.72	1.0
CE14-UC	489,600	1,541,326	4	3/6/2013	64.6	0.08	0.08	0.00	1.0
				9/5/2013	247.6	0.07	0.09	-0.02	1.0
				10/3/2014	640.4	0.06	0.10	-0.04	1.0
				4/1/2015	820.6	0.05	0.11	-0.06	1.0
				8/28/2015	969.6	0.06	0.12	-0.07	1.0
				3/19/2016	1173.6	0.07	0.14	-0.07	1.0
				3/21/2017	1540.0	0.04	0.05	-0.01	1.0
CE15-UC	489,460	1,539,507	4	3/6/2013	64.5	0.38	0.23	0.15	1.0
				9/5/2013	247.4	0.34	0.23	0.11	1.0
				10/3/2014	640.4	0.39	0.20	0.20	1.0
				4/1/2015	820.6	0.60	0.19	0.41	1.0
				3/19/2016	1173.6	1.26	0.19	1.07	1.0
				3/21/2017	1540.0	0.52	0.18	0.34	1.0
CE2-UC	489,979	1,541,923	4	2/26/2013	56.4	2.48	2.46	0.02	1.0
				9/30/2014	637.5	3.50	3.19	0.31	1.0
				5/13/2015	862.4	8.20	3.03	5.17	1.0
				10/16/2015	1018.6	4.80	2.87	1.93	1.0
				5/11/2016	1226.6	1.05	2.74	-1.69	1.0
				10/27/2016	1395.4	0.88	2.57	-1.69	1.0
				5/2/2017	1582.0	0.92	2.44	-1.52	1.0
				6/28/2017	1639.0	1.28	2.43	-1.15	1.0
				7/18/2017	1659.0	1.01	2.42	-1.41	1.0
				10/25/2017	1758.0	0.82	2.41	-1.59	1.0
CE5-UC	490,695	1,541,453	4	2/26/2013	56.5	0.54	0.64	-0.10	1.0
				9/30/2014	637.5	3.80	0.22	3.58	1.0
				7/17/2015	927.5	4.71	0.15	4.56	1.0
				7/16/2016	1292.6	2.00	0.18	1.82	1.0
				2/10/2017	1501.0	2.59	0.15	2.44	1.0
				7/19/2017	1660.0	0.25	0.13	0.12	1.0
CE6-UC	490,433	1,541,698	4	2/26/2013	56.4	3.46	2.11	1.35	1.0
				9/30/2014	637.5	4.32	1.83	2.49	1.0
				7/17/2015	927.6	4.78	1.91	2.87	1.0
				7/19/2016	1295.3	1.66	2.13	-0.47	1.0

Table D-1. Groundwater Transport Model Uranium Calibration Data

Well ID	Easting	Northing	Model Layer	Date	Model Time (days)	Measured Uranium Concentration (mg/L)	Simulated Uranium Concentration (mg/L)	Residual (mg/L)	Weight
				2/10/2017	1501.0	2.90	2.13	0.77	1.0
				7/19/2017	1660.0	2.22	2.09	0.13	1.0
CE7-UC	490,079	1,542,652	4	7/9/2013	189.4	26.0	18.3	7.66	1.0
				3/27/2015	815.4	23.8	15.4	8.39	1.0
				6/12/2015	892.5	25.2	15.4	9.84	1.0
				7/20/2017	1661.0	5.06	13.5	-8.48	1.0
CE8-UC	491,556	1,540,704	4	2/28/2013	58.5	0.06	0.04	0.01	1.0
				9/5/2013	247.4	0.04	0.04	0.00	1.0
				7/24/2014	569.5	0.06	0.04	0.02	1.0
				3/20/2015	808.4	0.04	0.04	0.00	1.0
				8/19/2015	960.5	0.04	0.04	0.00	1.0
				9/26/2015	998.4	0.04	0.04	0.00	1.0
				2/11/2016	1136.5	0.03	0.04	-0.01	1.0
				9/20/2016	1358.5	0.03	0.02	0.01	1.0
				3/2/2017	1521.0	0.03	0.02	0.02	1.0
CE9-UC	489,458	1,538,203	4	11/14/2017	1778.0	0.03	0.01	0.02	1.0
				2/28/2013	58.6	0.26	0.19	0.08	1.0
				10/11/2014	648.5	0.21	0.18	0.03	1.0
				3/27/2015	815.4	0.22	0.18	0.03	1.0
				8/19/2015	960.6	0.37	0.18	0.18	1.0
				3/16/2016	1170.5	0.52	0.18	0.34	1.0
				3/21/2017	1540.0	0.47	0.17	0.31	1.0
				7/19/2017	1660.0	0.25	0.15	0.10	1.0
CF1-UC	491,868	1,544,456	4	8/14/2017	1686.0	0.24	0.15	0.09	1.0
				3/5/2013	63.6	0.08	0.10	-0.02	1.0
				11/22/2013	325.6	8.11	0.10	8.01	1.0
				10/1/2014	638.6	7.07	0.10	6.97	1.0
CF2-UC	490,888	1,544,358	4	6/30/2017	1641.0	4.47	0.10	4.37	1.0
				3/5/2013	63.6	0.01	0.02	-0.01	1.0
				10/3/2014	640.3	0.01	0.02	-0.01	1.0
				6/30/2017	1641.0	0.01	0.02	-0.01	1.0
CW18-UC	491,378	1,535,924	4	2/26/2013	56.6	0.05	0.04	0.00	1.0
				10/4/2014	641.4	0.03	0.04	-0.01	1.0
				3/31/2015	819.5	0.03	0.04	-0.01	1.0

Table D-1. Groundwater Transport Model Uranium Calibration Data

Well ID	Easting	Northing	Model Layer	Date	Model Time (days)	Measured Uranium Concentration (mg/L)	Simulated Uranium Concentration (mg/L)	Residual (mg/L)	Weight
				8/25/2016	1332.6	0.03	0.04	-0.01	1.0
				3/20/2017	1539.0	0.02	0.04	-0.02	1.0
				8/17/2017	1689.0	0.03	0.04	-0.02	1.0
				8/17/2017	1689.0	0.03	0.04	-0.02	1.0
CW3-UC	493,496	1,545,200	4	2/28/2013	58.6	0.36	0.18	0.18	1.0
				10/3/2014	640.7	0.47	0.17	0.29	1.0
				7/2/2015	912.4	0.37	0.17	0.20	1.0
				11/28/2017	1792.0	0.32	0.02	0.30	1.0
CW40-UC	491,819	1,537,624	4	7/1/2015	911.6	0.03	0.02	0.01	1.0
				6/30/2017	1641.0	0.02	0.02	0.00	1.0
CW50-UC	491,159	1,546,687	4	11/27/2013	330.6	0.04	0.03	0.01	1.0
				10/1/2014	638.6	0.04	0.03	0.01	1.0
				3/11/2015	799.4	0.03	0.03	0.00	1.0
				8/19/2015	960.6	0.03	0.03	0.00	1.0
				3/17/2016	1171.5	0.03	0.03	0.00	1.0
				3/20/2017	1539.0	0.02	0.03	-0.01	1.0
				8/11/2017	1683.0	0.03	0.03	0.00	1.0
CW53-UC	490,262	1,536,668	4	11/15/2013	318.6	0.12	0.11	0.00	1.0
				4/16/2014	470.7	0.09	0.11	-0.03	1.0
				9/11/2014	618.7	0.10	0.11	-0.01	1.0
				5/13/2016	1228.5	0.09	0.11	-0.03	1.0
				10/22/2016	1390.6	0.06	0.11	-0.05	1.0
				5/3/2017	1583.0	0.07	0.11	-0.05	1.0
CW9-UC	491,015	1,542,840	4	10/3/2014	640.3	0.00	0.05	-0.04	1.0
				6/30/2017	1641.0	0.02	0.05	-0.03	1.0
0481-MC	490,210	1,536,820	6	5/11/2013	130.6	0.08	0.07	0.01	1.0
				6/12/2014	527.4	0.06	0.07	-0.01	1.0
0482-MC	489,579	1,536,981	6	7/10/2013	190.5	0.14	0.12	0.02	1.0
				5/15/2014	499.4	0.15	0.13	0.02	1.0
0483-MC	489,753	1,536,586	6	11/15/2013	318.7	0.14	0.13	0.02	1.0
				6/12/2014	527.5	0.13	0.13	0.00	1.0
				9/11/2014	618.7	0.12	0.13	-0.01	1.0
				5/13/2016	1228.6	0.21	0.13	0.07	1.0
0493-MC	489,492	1,536,702	6	2/9/2013	39.4	0.31	0.22	0.09	1.0

Table D-1. Groundwater Transport Model Uranium Calibration Data

Well ID	Easting	Northing	Model Layer	Date	Model Time (days)	Measured Uranium Concentration (mg/L)	Simulated Uranium Concentration (mg/L)	Residual (mg/L)	Weight
				7/9/2013	189.4	0.31	0.21	0.10	1.0
				2/13/2014	408.4	0.38	0.20	0.18	1.0
				2/13/2014	408.4	0.38	0.20	0.18	1.0
				6/17/2014	532.5	0.29	0.20	0.09	1.0
				3/5/2015	793.5	0.00	0.19	-0.19	1.0
				3/5/2015	793.5	0.19	0.19	0.00	1.0
				5/22/2015	871.4	0.14	0.19	-0.05	1.0
				2/16/2016	1141.6	0.19	0.18	0.01	1.0
				7/12/2016	1288.4	0.28	0.18	0.10	1.0
				3/1/2017	1520.0	0.16	0.17	-0.02	1.0
0498-MC	488,953	1,534,661	6	11/15/2013	318.6	0.50	0.29	0.21	1.0
				6/12/2014	527.5	0.52	0.31	0.22	1.0
				6/10/2015	890.6	0.21	0.29	-0.08	1.0
				7/6/2016	1282.5	0.35	0.29	0.06	1.0
				8/24/2017	1696.0	0.33	0.27	0.06	1.0
0859-MC	487,426	1,534,549	6	11/20/2013	323.4	0.06	0.06	-0.01	1.0
				6/19/2014	534.5	0.08	0.07	0.01	1.0
0930-MC	494,997	1,542,848	6	10/4/2014	641.4	0.02	0.01	0.01	1.0
				7/1/2015	911.6	0.00	0.01	-0.01	1.0
				7/5/2017	1646.0	0.00	0.01	-0.01	1.0
ACW-MC	488,070	1,540,235	6	12/10/2013	343.6	0.05	0.04	0.01	1.0
				10/11/2014	648.4	0.01	0.04	-0.02	1.0
				10/24/2015	1026.6	0.01	0.04	-0.03	1.0
				12/20/2016	1449.4	0.05	0.04	0.01	1.0
				11/30/2017	1794.0	0.01	0.04	-0.03	1.0
CW15-MC	485,961	1,536,259	6	10/2/2014	639.6	0.03	0.03	0.00	1.0
				7/1/2015	911.5	0.03	0.03	0.00	1.0
				6/30/2017	1641.0	0.03	0.03	0.00	1.0
CW17-MC	487,771	1,545,279	6	6/25/2013	175.5	0.70	0.68	0.02	1.0
				11/27/2013	330.6	0.58	0.68	-0.10	1.0
				10/1/2014	638.5	0.47	0.68	-0.21	1.0
				7/2/2015	912.6	0.42	0.69	-0.26	1.0
				12/17/2016	1446.6	0.27	0.69	-0.42	1.0
				6/29/2017	1640.0	0.25	0.19	0.06	1.0

Table D-1. Groundwater Transport Model Uranium Calibration Data

Well ID	Easting	Northing	Model Layer	Date	Model Time (days)	Measured Uranium Concentration (mg/L)	Simulated Uranium Concentration (mg/L)	Residual (mg/L)	Weight
				10/23/2017	1756.0	0.23	0.13	0.09	1.0
CW1-MC	490,295	1,545,235	6	2/28/2013	58.6	0.05	0.05	0.00	1.0
				7/2/2015	912.5	0.06	0.05	0.00	1.0
CW24-MC	487,760	1,545,773	6	8/7/2015	948.5	0.13	0.14	-0.01	1.0
				7/31/2017	1672.0	0.13	0.14	-0.01	1.0
CW28-MC	491,008	1,535,112	6	2/26/2013	56.6	0.04	0.03	0.00	1.0
				10/4/2014	641.4	0.03	0.03	-0.01	1.0
				7/2/2015	912.6	0.02	0.03	-0.01	1.0
				12/12/2017	1806.0	0.04	0.03	0.00	1.0
CW2-MC	491,302	1,545,212	6	2/12/2013	42.4	0.05	0.05	-0.01	1.0
				2/28/2013	58.6	0.51	0.05	0.46	1.0
				11/5/2013	308.6	0.06	0.05	0.01	1.0
				2/12/2014	407.5	0.04	0.05	-0.01	1.0
				9/5/2014	612.7	0.07	0.05	0.02	1.0
				7/2/2015	912.4	0.04	0.05	-0.02	1.0
				8/7/2015	948.6	0.05	0.05	0.00	1.0
				2/11/2016	1136.5	0.04	0.05	-0.01	1.0
				9/27/2016	1365.4	0.04	0.05	-0.02	1.0
				3/21/2017	1540.0	0.04	0.05	-0.01	1.0
CW44-MC	488,891	1,535,048	6	8/10/2017	1682.0	0.04	0.05	-0.01	1.0
				11/15/2013	318.6	0.32	0.32	0.00	1.0
				6/12/2014	527.5	0.30	0.32	-0.02	1.0
				9/10/2014	617.7	0.26	0.32	-0.06	1.0
				7/30/2015	940.4	0.25	0.32	-0.07	1.0
				7/6/2016	1282.6	0.27	0.31	-0.04	1.0
CW45-MC	489,494	1,535,036	6	12/2/2016	1431.6	0.22	0.31	-0.09	1.0
				3/7/2013	65.4	0.48	0.28	0.20	1.0
				6/18/2013	168.4	0.45	0.26	0.19	1.0
				11/15/2013	318.6	0.48	0.23	0.26	1.0
				11/14/2014	682.6	0.35	0.20	0.15	1.0
				12/24/2014	722.4	0.35	0.20	0.16	1.0
				4/1/2015	820.5	0.44	0.19	0.24	1.0
				4/1/2015	820.5	0.34	0.19	0.15	1.0
				8/20/2015	961.4	0.39	0.19	0.20	1.0

Table D-1. Groundwater Transport Model Uranium Calibration Data

Well ID	Easting	Northing	Model Layer	Date	Model Time (days)	Measured Uranium Concentration (mg/L)	Simulated Uranium Concentration (mg/L)	Residual (mg/L)	Weight
				3/5/2016	1159.5	0.40	0.18	0.22	1.0
				8/27/2016	1334.5	0.39	0.17	0.22	1.0
				3/24/2017	1543.0	0.35	0.16	0.19	1.0
				8/15/2017	1687.0	0.34	0.15	0.18	1.0
CW55-MC	489,471	1,538,283	6	12/4/2013	337.1	0.07	0.07	0.00	1.0
				10/11/2014	648.5	0.09	0.07	0.02	1.0
				7/30/2015	940.5	0.09	0.07	0.03	1.0
				12/12/2017	1806.0	0.17	0.07	0.10	1.0
CW56-MC	488,115	1,545,279	6	5/2/2013	121.5	4.28	3.61	0.67	1.0
				8/8/2013	219.5	3.73	3.61	0.12	1.0
				10/1/2014	638.6	2.97	3.54	-0.57	1.0
				2/21/2015	781.6	3.09	3.53	-0.44	1.0
				8/28/2015	969.5	2.40	3.53	-1.13	1.0
				12/17/2016	1446.6	0.66	3.37	-2.71	1.0
				8/16/2017	1688.0	0.54	3.23	-2.70	1.0
				10/24/2017	1757.0	0.44	3.19	-2.75	1.0
CW57-MC	488,070	1,545,654	6	5/11/2013	130.4	0.16	0.13	0.03	1.0
				10/1/2014	638.5	0.16	0.13	0.03	1.0
				2/21/2015	781.5	0.18	0.13	0.05	1.0
				9/1/2015	973.4	0.16	0.13	0.03	1.0
				10/24/2017	1757.0	0.16	0.13	0.03	1.0
CW60-MC	488,262	1,545,470	6	5/11/2013	130.4	0.14	0.14	0.00	1.0
				10/1/2014	638.5	0.12	0.15	-0.03	1.0
				2/21/2015	781.5	0.12	0.15	-0.03	1.0
				9/1/2015	973.4	0.11	0.16	-0.05	1.0
				8/16/2017	1688.0	0.11	0.16	-0.05	1.0
				10/24/2017	1757.0	0.11	0.16	-0.06	1.0
CW61-MC	487,779	1,544,927	6	5/11/2013	130.5	3.64	3.82	-0.18	1.0
				10/1/2014	638.4	3.00	3.76	-0.76	1.0
				4/1/2015	820.5	3.23	3.76	-0.53	1.0
				8/29/2015	970.6	3.38	3.76	-0.38	1.0
				12/17/2016	1446.5	1.67	3.60	-1.93	1.0
CW62-MC	487,847	1,544,555	6	5/15/2013	134.4	3.04	3.11	-0.07	1.0
				10/1/2014	638.4	2.90	2.82	0.08	1.0

Table D-1. Groundwater Transport Model Uranium Calibration Data

Well ID	Easting	Northing	Model Layer	Date	Model Time (days)	Measured Uranium Concentration (mg/L)	Simulated Uranium Concentration (mg/L)	Residual (mg/L)	Weight
				4/1/2015	820.5	3.08	2.79	0.29	1.0
				8/29/2015	970.6	3.10	2.77	0.33	1.0
				5/19/2016	1234.5	2.33	2.60	-0.27	1.0
				10/28/2016	1396.4	1.21	2.46	-1.25	1.0
				12/1/2016	1430.6	1.07	2.44	-1.37	1.0
				12/15/2016	1444.5	1.36	2.43	-1.07	1.0
				2/10/2017	1501.0	1.02	2.40	-1.38	1.0
				5/3/2017	1583.0	1.10	2.36	-1.26	1.0
				8/16/2017	1688.0	1.35	2.30	-0.95	1.0
				11/29/2017	1793.0	1.11	2.25	-1.14	1.0
CW6-MC	488,301	1,542,588	6	10/1/2014	638.4	0.06	0.02	0.04	1.0
WCW-MC	488,520	1,541,045	6	11/27/2013	330.6	0.00	0.01	-0.01	1.0
				7/30/2015	940.6	0.01	0.01	0.00	1.0
				8/9/2017	1681.0	0.00	0.01	0.00	1.0
				8/11/2017	1683.0	0.01	0.01	0.00	1.0
WR25-MC	487,430	1,545,267	6	6/25/2013	175.6	0.29	0.30	-0.01	1.0
				10/1/2014	638.5	0.25	0.30	-0.05	1.0
				7/30/2015	940.4	0.17	0.30	-0.13	1.0
				7/31/2017	1672.0	0.18	0.30	-0.13	1.0
0538-LC	486,899	1,533,486	8	3/19/2013	77.4	0.17	0.19	-0.01	1.0
				4/2/2014	456.5	0.21	0.19	0.02	1.0
				7/19/2014	564.4	0.22	0.19	0.03	1.0
				8/10/2016	1317.6	0.20	0.19	0.01	1.0
0653-LC	486,570	1,533,283	8	6/18/2013	168.5	0.28	0.23	0.05	1.0
				11/15/2013	318.6	0.28	0.22	0.06	1.0
				7/19/2014	564.5	0.26	0.22	0.04	1.0
				8/2/2016	1309.6	0.27	0.21	0.06	1.0
0853-LC	484,824	1,532,124	8	6/19/2014	534.6	0.06	0.05	0.01	1.0
				7/2/2015	912.4	0.08	0.05	0.04	1.0
				7/6/2017	1647.0	0.10	0.05	0.05	1.0
CW29-LC	487,435	1,534,551	8	3/20/2013	78.6	0.22	0.18	0.04	1.0
				6/18/2013	168.5	0.21	0.18	0.03	1.0
				10/4/2014	641.5	0.22	0.18	0.04	1.0
				3/20/2015	808.6	0.21	0.18	0.03	1.0

Table D-1. Groundwater Transport Model Uranium Calibration Data

Well ID	Easting	Northing	Model Layer	Date	Model Time (days)	Measured Uranium Concentration (mg/L)	Simulated Uranium Concentration (mg/L)	Residual (mg/L)	Weight
				8/20/2015	961.4	0.19	0.18	0.01	1.0
				5/7/2016	1222.4	0.16	0.18	-0.02	1.0
				3/20/2017	1539.0	0.18	0.18	0.00	1.0
				8/14/2017	1686.0	0.19	0.18	0.01	1.0
CW31-LC	482,738	1,540,689	8	12/4/2013	337.5	0.02	0.01	0.01	1.0
				10/2/2014	639.5	0.01	0.01	0.00	1.0
				7/3/2015	913.4	0.01	0.01	0.00	1.0
				12/21/2016	1450.4	0.01	0.01	-0.01	1.0
				6/29/2017	1640.0	0.01	0.01	0.00	1.0
CW32-LC	483,523	1,543,413	8	12/4/2013	337.5	0.00	0.00	0.00	1.0
				10/2/2014	639.4	0.00	0.00	0.00	1.0
				7/3/2015	913.3	0.00	0.00	0.00	1.0
				12/21/2016	1450.4	0.00	0.00	0.00	1.0
				6/29/2017	1640.0	0.01	0.00	0.00	1.0
CW33-LC	486,347	1,543,814	8	10/2/2014	639.3	0.01	0.01	0.00	1.0
				7/2/2015	912.6	0.02	0.01	0.01	1.0
				6/29/2017	1640.0	0.01	0.01	0.00	1.0
CW36-LC	481,329	1,540,053	8	10/2/2014	639.4	0.00	0.01	0.00	1.0
				7/18/2015	928.4	0.01	0.01	0.00	1.0
				7/31/2017	1672.0	0.01	0.01	0.00	1.0
CW37-LC	484,853	1,537,240	8	10/2/2014	639.6	0.03	0.03	0.00	1.0
				7/1/2015	911.5	0.03	0.03	0.00	1.0
				10/9/2016	1377.6	0.03	0.03	0.00	1.0
				6/29/2017	1640.0	0.03	0.03	0.00	1.0
CW41-LC	488,583	1,533,174	8	11/20/2013	323.4	0.03	0.05	-0.02	1.0
				10/2/2014	639.6	0.06	0.05	0.00	1.0
				7/21/2015	931.4	0.08	0.05	0.03	1.0
				8/10/2016	1317.6	0.04	0.05	-0.02	1.0
				7/31/2017	1672.0	0.10	0.05	0.05	1.0
CW42-LC	487,177	1,533,169	8	6/18/2013	168.6	0.28	0.24	0.04	1.0
				11/15/2013	318.6	0.32	0.24	0.08	1.0
				10/11/2014	648.6	0.32	0.24	0.09	1.0
				8/19/2015	960.6	0.25	0.23	0.01	1.0
				8/10/2016	1317.7	0.27	0.23	0.04	1.0

Table D-1. Groundwater Transport Model Uranium Calibration Data

Well ID	Easting	Northing	Model Layer	Date	Model Time (days)	Measured Uranium Concentration (mg/L)	Simulated Uranium Concentration (mg/L)	Residual (mg/L)	Weight
				8/25/2016	1332.6	0.23	0.23	0.00	1.0
				3/21/2017	1540.0	0.21	0.23	-0.02	1.0
				8/14/2017	1686.0	0.22	0.22	-0.01	1.0
CW43-LC	482,493	1,537,587	8	12/4/2013	337.5	0.05	0.04	0.01	1.0
				10/2/2014	639.5	0.05	0.04	0.01	1.0
				7/18/2015	928.6	0.05	0.04	0.02	1.0
				12/21/2016	1450.5	0.05	0.04	0.01	1.0
				8/1/2017	1673.0	0.05	0.04	0.01	1.0
#1_Deepwell-SA	493,633	1,543,307	10	5/7/2013	126.4	0.01	0.02	-0.01	1.0
				11/6/2013	309.6	0.01	0.02	-0.01	1.0
				5/15/2014	499.6	0.01	0.02	-0.01	1.0
				11/6/2014	674.4	0.01	0.02	-0.01	1.0
				2/18/2015	778.6	0.01	0.02	-0.01	1.0
				5/2/2015	851.4	0.01	0.02	-0.01	1.0
				8/8/2015	949.6	0.01	0.02	-0.01	1.0
				10/9/2015	1011.4	0.01	0.02	-0.01	1.0
				2/16/2016	1141.6	0.01	0.02	-0.01	1.0
				5/5/2016	1220.3	0.01	0.02	-0.01	1.0
				7/10/2016	1286.4	0.01	0.02	-0.01	1.0
				10/18/2016	1386.4	0.01	0.02	-0.01	1.0
#2_Deepwell-SA	490,972	1,542,424	10	5/7/2013	126.5	0.01	0.02	-0.01	1.0
				11/5/2013	308.6	0.01	0.02	-0.01	1.0
				5/15/2014	499.6	0.01	0.02	-0.01	1.0
				11/6/2014	674.4	0.02	0.02	0.00	1.0
				2/18/2015	778.6	0.01	0.02	-0.01	1.0
				5/2/2015	851.4	0.01	0.02	-0.01	1.0
				8/8/2015	949.6	0.01	0.02	-0.01	1.0
				10/9/2015	1011.4	0.01	0.02	-0.01	1.0
				2/16/2016	1141.6	0.01	0.02	-0.01	1.0
				5/5/2016	1220.3	0.01	0.02	-0.01	1.0
				7/10/2016	1286.4	0.01	0.02	-0.01	1.0
				10/18/2016	1386.4	0.01	0.02	-0.01	1.0
				2/16/2017	1507.0	0.01	0.02	-0.01	1.0
				5/2/2017	1582.0	0.01	0.02	-0.01	1.0

Table D-1. Groundwater Transport Model Uranium Calibration Data

Well ID	Easting	Northing	Model Layer	Date	Model Time (days)	Measured Uranium Concentration (mg/L)	Simulated Uranium Concentration (mg/L)	Residual (mg/L)	Weight
				7/18/2017	1659.0	0.01	0.02	-0.01	1.0
				10/25/2017	1758.0	0.02	0.02	0.00	1.0
				11/20/2017	1784.0	0.01	0.02	-0.01	1.0
0806R-SA	486,263	1,541,177	10	7/9/2014	554.4	0.02	0.02	0.00	1.0
				10/9/2014	646.6	0.03	0.02	0.01	1.0
				10/16/2015	1018.5	0.02	0.02	0.00	1.0
				5/4/2017	1584.0	0.11	0.02	0.09	1.0
0806-SA	486,320	1,541,120	10	10/10/2014	647.5	0.00	0.02	-0.02	1.0
0928-SA	491,700	1,548,250	10	1/27/2016	1121.4	0.09	0.02	0.07	1.0
0938-SA	473,040	1,539,500	10	10/14/2015	1016.6	0.01	0.02	-0.01	1.0
0943-SA	487,407	1,537,222	10	2/20/2014	415.4	0.03	0.02	0.01	1.0
				11/18/2014	686.4	0.03	0.02	0.01	1.0
				2/18/2015	778.6	0.03	0.02	0.01	1.0
				5/1/2015	850.4	0.03	0.02	0.01	1.0
				8/8/2015	949.6	0.03	0.02	0.01	1.0
				10/9/2015	1011.6	0.08	0.02	0.06	1.0
				12/11/2015	1074.5	0.03	0.02	0.01	1.0
				1/27/2016	1121.4	0.04	0.02	0.02	1.0
				2/26/2016	1151.4	0.04	0.02	0.02	1.0
				9/16/2016	1354.4	0.08	0.02	0.06	1.0
				10/19/2016	1387.4	0.10	0.02	0.08	1.0
				2/10/2017	1501.0	0.09	0.02	0.07	1.0
				2/17/2017	1508.0	0.09	0.02	0.07	1.0
				2/28/2017	1519.0	0.07	0.02	0.05	1.0
				5/3/2017	1583.0	0.06	0.02	0.04	1.0
				5/11/2017	1591.0	0.06	0.02	0.04	1.0
				7/19/2017	1660.0	0.12	0.02	0.10	1.0
				8/28/2017	1700.0	0.12	0.02	0.10	1.0
				10/17/2017	1750.0	0.09	0.02	0.07	1.0
0951R-SA	484,100	1,544,500	10	3/7/2013	65.6	0.04	0.02	0.02	1.0
				12/19/2014	717.6	0.08	0.02	0.06	1.0
				2/18/2015	778.6	0.05	0.02	0.03	1.0
				5/1/2015	850.4	0.04	0.02	0.02	1.0
				8/8/2015	949.6	0.03	0.02	0.01	1.0

Table D-1. Groundwater Transport Model Uranium Calibration Data

Well ID	Easting	Northing	Model Layer	Date	Model Time (days)	Measured Uranium Concentration (mg/L)	Simulated Uranium Concentration (mg/L)	Residual (mg/L)	Weight
				8/11/2015	952.5	0.03	0.02	0.01	1.0
				10/9/2015	1011.4	0.03	0.02	0.01	1.0
				2/20/2016	1145.5	0.03	0.02	0.01	1.0
				9/2/2016	1340.6	0.04	0.02	0.02	1.0
				10/18/2016	1386.6	0.04	0.02	0.02	1.0
				2/16/2017	1507.0	0.03	0.02	0.01	1.0
				5/2/2017	1582.0	0.04	0.02	0.02	1.0
				6/27/2017	1638.0	0.04	0.02	0.02	1.0
				7/18/2017	1659.0	0.03	0.02	0.01	1.0
				10/23/2017	1756.0	0.04	0.02	0.02	1.0
0951-SA	473,200	1,545,500	10	6/25/2015	905.4	0.03	0.02	0.01	1.0
				5/11/2016	1226.4	0.03	0.02	0.01	1.0
				5/10/2017	1590.0	0.03	0.02	0.01	1.0
				11/15/2017	1779.0	0.03	0.02	0.01	1.0
0998-SA	476,450	1,533,080	10	10/23/2014	660.4	0.01	0.02	-0.01	1.0
				10/1/2015	1003.4	0.01	0.02	-0.01	1.0
				12/15/2016	1444.6	0.01	0.02	-0.01	1.0
OLD_#1-SA	493,775	1,543,798	10	7/6/2016	1282.4	0.05	0.02	0.03	1.0
				7/12/2016	1288.6	0.03	0.02	0.01	1.0

Appendix E: Molybdenum Transport Calibration Target Dataset

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Table E-1. Groundwater Transport Model Molybdenum Calibration Data

Well ID	Easting	Northing	Model Layer	Date	Model Time (days)	Measured Molybdenum Concentration (mg/L)	Simulated Molybdenum Concentration (mg/L)	Residual (mg/L)	Weight
0481-AI	490,210	1,536,820	1	12/24/2014	131	<0.03	0.00	0.03	1.0
				3/5/2016	527	<0.03	0.00	0.03	1.0
0482-AI	489,579	1,536,981	1	11/15/2013	191	0.06	0.05	0.01	1.0
				6/12/2014	499	0.06	0.04	0.02	1.0
0483-AI	489,753	1,536,586	1	8/24/2017	319	0.04	0.08	-0.04	1.0
				5/14/2013	528	0.05	0.07	-0.02	1.0
				1/29/2014	619	0.05	0.07	-0.02	1.0
				4/27/2017	1229	0.05	0.04	0.01	1.0
0490-AI	489,752	1,536,553	1	12/15/2016	309	0.04	0.08	-0.04	1.0
				7/19/2014	326	0.13	0.08	0.05	1.0
				8/10/2016	528	0.06	0.08	-0.02	1.0
				5/4/2013	871	<0.03	0.06	-0.03	1.0
				11/15/2013	1019	<0.03	0.05	-0.02	1.0
				10/4/2014	1229	0.07	0.04	0.03	1.0
				5/15/2015	1391	0.04	0.04	0.00	1.0
				4/29/2016	1528	<0.03	0.03	0.00	1.0
0491-AI	489,658	1,537,031	1	8/5/2016	191	0.05	0.04	0.01	1.0
				11/6/2017	499	<0.03	0.04	-0.01	1.0
				8/9/2013	626	0.09	0.03	0.06	1.0
				7/22/2015	626	<0.03	0.03	0.00	1.0
0496-AI	489,603	1,534,650	1	2/6/2013	65	<0.03	0.00	0.03	1.0
				8/16/2013	319	<0.03	0.01	0.02	1.0
				2/12/2014	456	<0.03	0.01	0.02	1.0
0497-AI	489,503	1,535,039	1	9/4/2014	168	<0.03	0.04	-0.01	1.0
				2/26/2015	319	<0.03	0.03	0.00	1.0
				2/17/2016	456	<0.03	0.03	0.00	1.0
				3/27/2017	528	<0.03	0.04	-0.01	1.0
				2/6/2013	556	<0.03	0.04	-0.01	1.0
				8/16/2013	683	<0.03	0.04	-0.01	1.0
				2/12/2014	722	<0.03	0.04	-0.01	1.0
				9/4/2014	1159	<0.03	0.05	-0.02	1.0
				2/26/2015	1536	<0.03	0.06	-0.03	1.0
				2/11/2016	1638	<0.03	0.07	-0.04	1.0

Table E-1. Groundwater Transport Model Molybdenum Calibration Data

Well ID	Easting	Northing	Model Layer	Date	Model Time (days)	Measured Molybdenum Concentration (mg/L)	Simulated Molybdenum Concentration (mg/L)	Residual (mg/L)	Weight
0498-AI	488,953	1,534,661	1	3/27/2017	319	<0.03	0.00	0.03	1.0
				2/6/2013	528	<0.03	0.00	0.03	1.0
				8/16/2013	891	<0.03	0.00	0.03	1.0
				2/12/2014	1283	<0.03	0.00	0.03	1.0
				9/4/2014	1696	<0.03	0.01	0.02	1.0
0522-AI	492,437	1,538,640	1	12/28/2016	134	1.40	1.21	0.19	1.0
				6/30/2017	394	1.68	0.86	0.82	1.0
				3/7/2013	1577	1.29	0.17	1.12	1.0
0531-AI	478,262	1,541,086	1	4/2/2014	1017	<0.03	0.00	0.03	1.0
0532-AI	482,400	1,518,700	1	6/30/2017	80	<0.03	0.00	1.03	1.0
				7/30/2014	660	<0.03	0.00	1.03	1.0
				4/23/2015	1003	<0.03	0.00	1.03	1.0
				5/6/2015	1445	<0.03	0.00	1.03	1.0
0538-AI	486,899	1,533,486	1	6/17/2015	564	<0.03	0.00	0.03	1.0
				8/20/2015	1318	<0.03	0.00	0.03	1.0
0540-AI	488,091	1,534,125	1	2/19/2016	123	<0.03	0.00	0.03	1.0
				4/6/2016	318	<0.03	0.00	0.03	1.0
				7/24/2016	641	<0.03	0.00	0.03	1.0
				10/22/2016	864	<0.03	0.00	0.03	1.0
				12/1/2016	1215	<0.03	0.00	0.03	1.0
				7/11/2017	1312	<0.03	0.00	0.03	1.0
				12/13/2017	1770	<0.03	0.00	0.03	1.0
0541-AI	477,236	1,539,831	1	12/21/2016	221	<0.03	0.00	0.03	1.0
				10/6/2017	933	<0.03	0.00	0.03	1.0
				7/1/2015	1459	<0.03	0.00	0.03	1.0
0551-AI	479,880	1,536,272	1	7/1/2015	37	<0.03	0.00	0.03	1.0
				10/11/2014	221	<0.03	0.00	0.03	1.0
				8/2/2016	410	<0.03	0.00	0.03	1.0
				9/4/2014	604	<0.03	0.00	0.03	1.0
				8/2/2016	781	<0.03	0.00	0.03	1.0
				11/14/2017	1137	<0.03	0.00	0.03	1.0
				2/7/2013	1515	<0.03	0.00	0.03	1.0
				8/9/2013	1547	<0.03	0.00	0.03	1.0
0553-AI	480,563	1,534,923	1	8/28/2014	37	<0.03	0.00	0.03	1.0

Table E-1. Groundwater Transport Model Molybdenum Calibration Data

Well ID	Easting	Northing	Model Layer	Date	Model Time (days)	Measured Molybdenum Concentration (mg/L)	Simulated Molybdenum Concentration (mg/L)	Residual (mg/L)	Weight
				9/14/2017	221	<0.03	0.00	0.03	1.0
				2/7/2013	410	<0.03	0.00	0.03	1.0
				3/7/2013	604	<0.03	0.00	0.03	1.0
				8/16/2013	781	<0.03	0.00	0.03	1.0
				4/2/2014	1137	<0.03	0.00	0.03	1.0
				3/5/2015	1546	<0.03	0.00	0.03	1.0
0554-AI	479,107	1,534,967	1	2/23/2016	37	<0.03	0.00	0.03	1.0
				3/15/2017	221	<0.03	0.00	0.03	1.0
				2/7/2013	410	<0.03	0.00	0.03	1.0
				8/16/2013	781	<0.03	0.00	0.03	1.0
				2/26/2014	1546	<0.03	0.00	0.03	1.0
0555-AI	486,236	1,538,572	1	9/4/2014	36	<0.03	0.00	0.03	1.0
				3/18/2015	227	<0.03	0.00	0.03	1.0
				2/12/2016	408	<0.03	0.00	0.03	1.0
				3/27/2017	611	<0.03	0.00	0.03	1.0
				11/15/2013	787	<0.03	0.00	0.03	1.0
				7/19/2014	1143	<0.03	0.00	0.03	1.0
				8/2/2016	1546	<0.03	0.00	0.03	1.0
0556-AI	486,184	1,538,006	1	6/10/2015	36	<0.03	0.00	0.03	1.0
				11/14/2017	227	<0.03	0.00	0.03	1.0
				5/14/2013	408	<0.03	0.00	0.03	1.0
				2/7/2013	611	<0.03	0.00	0.03	1.0
				10/30/2013	787	<0.03	0.00	0.03	1.0
				2/26/2014	1137	<0.03	0.00	0.03	1.0
				8/27/2014	1546	<0.03	0.00	0.03	1.0
0557-AI	486,000	1,537,204	1	2/20/2015	36	<0.03	0.00	0.03	1.0
				2/21/2017	228	<0.03	0.00	0.03	1.0
				4/23/2015	408	<0.03	0.00	0.03	1.0
				5/6/2015	611	<0.03	0.00	0.03	1.0
				6/17/2015	787	<0.03	0.00	0.03	1.0
				8/20/2015	1137	<0.03	0.00	0.03	1.0
				9/30/2015	1546	<0.03	0.00	0.03	1.0
0631-AI	483,756	1,532,234	1	2/19/2016	65	<0.03	0.00	0.03	1.0
				2/24/2016	456	<0.03	0.00	0.03	1.0

Table E-1. Groundwater Transport Model Molybdenum Calibration Data

Well ID	Easting	Northing	Model Layer	Date	Model Time (days)	Measured Molybdenum Concentration (mg/L)	Simulated Molybdenum Concentration (mg/L)	Residual (mg/L)	Weight
				4/6/2016	1457	<0.03	0.00	0.03	1.0
				7/24/2016	1641	<0.03	0.00	0.03	1.0
0632-AI	483,767	1,531,850	1	10/22/2016	65	<0.03	0.00	0.04	1.0
				3/20/2017	456	<0.03	0.00	0.04	1.0
				3/19/2013	1641	<0.03	0.00	0.04	1.0
0634-AI	480,362	1,541,652	1	3/27/2015	575	<0.03	0.03	0.00	1.0
				10/14/2015	842	<0.03	0.03	0.00	1.0
				12/12/2014	855	<0.03	0.03	0.00	1.0
				12/21/2016	897	<0.03	0.03	0.00	1.0
				10/6/2017	961	<0.03	0.03	0.00	1.0
				3/5/2013	1002	<0.03	0.03	0.00	1.0
				10/30/2013	1106	0.04	0.02	0.02	1.0
				3/20/2014	1145	<0.03	0.02	0.01	1.0
				3/13/2015	1192	<0.03	0.02	0.01	1.0
				3/17/2016	1300	<0.03	0.02	0.01	1.0
				3/27/2017	1391	0.04	0.02	0.02	1.0
				8/9/2017	1431	<0.03	0.02	0.01	1.0
				2/20/2013	1652	<0.03	0.01	0.02	1.0
				4/25/2017	1807	<0.03	0.01	0.02	1.0
0637-AI	474,710	1,545,409	1	2/20/2013	1451	<0.03	0.03	0.00	1.0
				4/25/2017	1739	<0.03	0.03	0.00	1.0
0641-AI	491,110	1,536,494	1	7/1/2015	912	<0.03	0.00	0.03	1.0
0642-AI	490,932	1,536,104	1	3/5/2013	912	<0.03	0.01	0.02	1.0
0644-AI	485,450	1,533,481	1	3/19/2014	649	<0.03	0.00	0.03	1.0
				3/19/2014	1310	<0.03	0.00	0.03	1.0
0646-AI	484,952	1,533,246	1	9/9/2014	611	<0.03	0.00	0.03	1.0
				3/20/2015	1310	<0.03	0.00	0.03	1.0
				8/7/2015	1778	<0.03	0.00	0.03	1.0
0647-AI	478,308	1,536,623	1	3/16/2016	37	<0.03	0.00	0.03	1.0
				9/9/2016	221	<0.03	0.00	0.03	1.0
				3/14/2017	604	<0.03	0.00	0.03	1.0
				8/9/2017	1717	<0.03	0.00	0.03	1.0
0649-AI	479,798	1,534,730	1	2/6/2013	37	<0.03	0.01	0.02	1.0
				8/16/2013	66	0.05	0.01	0.04	1.0

Table E-1. Groundwater Transport Model Molybdenum Calibration Data

Well ID	Easting	Northing	Model Layer	Date	Model Time (days)	Measured Molybdenum Concentration (mg/L)	Simulated Molybdenum Concentration (mg/L)	Residual (mg/L)	Weight
				2/26/2014	228	<0.03	0.01	0.02	1.0
				9/4/2014	457	<0.03	0.01	0.02	1.0
				2/26/2015	793	<0.03	0.01	0.02	1.0
				2/20/2016	1148	<0.03	0.01	0.02	1.0
				3/27/2017	1534	<0.03	0.01	0.02	1.0
0650-AI	482,135	1,536,779	1	2/6/2013	38	<0.03	0.00	0.03	1.0
				8/16/2013	228	<0.03	0.00	0.03	1.0
				2/26/2014	422	<0.03	0.00	0.03	1.0
				9/4/2014	612	<0.03	0.00	0.03	1.0
				2/26/2015	806	<0.03	0.00	0.03	1.0
				2/20/2016	1138	<0.03	0.00	0.03	1.0
				3/27/2017	1546	<0.03	0.00	0.03	1.0
0653-AI	486,570	1,533,283	1	2/20/2013	319	<0.03	0.00	0.03	1.0
				2/20/2013	564	<0.03	0.00	0.03	1.0
				10/30/2013	1310	<0.03	0.00	0.03	1.0
0654-AI	478,636	1,541,994	1	7/1/2015	891	<0.03	0.01	0.02	1.0
				8/20/2015	1778	<0.03	0.02	0.01	1.0
0657-AI	478,392	1,537,497	1	2/12/2016	134	<0.03	0.00	0.03	1.0
0658-AI	478,436	1,535,922	1	3/27/2017	37	<0.03	0.00	0.03	1.0
				8/9/2017	302	<0.03	0.00	0.03	1.0
				7/1/2015	421	<0.03	0.00	0.03	1.0
				5/4/2013	604	<0.03	0.00	0.03	1.0
				1/29/2014	781	<0.03	0.00	0.03	1.0
				6/12/2014	1512	<0.03	0.00	0.03	1.0
0659-AI	480,772	1,541,689	1	10/18/2014	842	<0.03	0.02	0.01	1.0
				5/15/2015	856	<0.03	0.02	0.01	1.0
				5/7/2016	897	<0.03	0.02	0.01	1.0
				8/5/2016	962	<0.03	0.02	0.01	1.0
				10/25/2016	1002	<0.03	0.02	0.01	1.0
				12/1/2016	1145	<0.03	0.02	0.01	1.0
				3/21/2017	1149	0.04	0.02	0.02	1.0
				2/26/2013	1192	<0.03	0.02	0.01	1.0
				8/21/2015	1300	<0.03	0.01	0.02	1.0
				8/10/2016	1391	0.04	0.01	0.03	1.0

Table E-1. Groundwater Transport Model Molybdenum Calibration Data

Well ID	Easting	Northing	Model Layer	Date	Model Time (days)	Measured Molybdenum Concentration (mg/L)	Simulated Molybdenum Concentration (mg/L)	Residual (mg/L)	Weight
				8/18/2017	1539	<0.03	0.01	0.02	1.0
0681-AI	482,734	1,540,676	1	10/18/2014	77	<0.03	0.00	0.03	1.0
				5/15/2015	816	<0.03	0.00	0.03	1.0
0684-AI	478,499	1,540,273	1	8/21/2015	1017	<0.03	0.00	0.03	1.0
0686-AI	475,438	1,545,319	1	4/29/2016	711	<0.03	0.04	-0.01	1.0
				8/5/2016	1451	<0.03	0.03	0.00	1.0
				5/4/2013	1739	<0.03	0.03	0.00	1.0
0688-AI	483,954	1,541,257	1	8/6/2014	63	<0.03	0.00	0.03	1.0
				9/12/2014	303	<0.03	0.00	0.03	1.0
				10/18/2014	444	<0.03	0.00	0.03	1.0
				10/22/2014	802	<0.03	0.00	0.03	1.0
				11/14/2014	1171	<0.03	0.00	0.03	1.0
				12/24/2014	1546	<0.03	0.00	0.03	1.0
				8/21/2015	1681	<0.03	0.00	0.03	1.0
0690-AI	493,465	1,540,279	1	8/5/2016	51	1.34	1.40	-0.06	1.0
				12/1/2016	1575	0.81	1.10	-0.29	1.0
0691-AI	493,860	1,540,276	1	3/21/2017	51	0.13	0.32	-0.19	1.0
				8/17/2017	1575	0.26	0.33	-0.07	1.0
0692-AI	493,175	1,535,892	1	7/1/2015	911	<0.03	0.00	0.03	1.0
0802-AI	488,277	1,540,765	1	3/19/2013	63	<0.03	0.00	0.03	1.0
				6/18/2013	442	<0.03	0.00	0.03	1.0
				7/19/2014	442	0.04	0.00	0.04	1.0
				2/9/2013	617	<0.03	0.00	0.03	1.0
				10/31/2013	808	<0.03	0.00	0.03	1.0
				2/12/2014	948	<0.03	0.00	0.03	1.0
				8/27/2014	1170	0.23	0.00	0.23	1.0
				2/27/2015	1348	<0.03	0.00	0.03	1.0
				2/19/2016	1533	<0.03	0.00	0.03	1.0
				2/23/2017	1681	0.17	0.00	0.17	1.0
0844-AI	487,002	1,538,376	1	2/19/2016	36	<0.03	0.00	0.03	1.0
				3/15/2017	227	<0.03	0.00	0.03	1.0
				2/9/2013	421	<0.03	0.00	0.03	1.0
				8/9/2013	611	<0.03	0.00	0.03	1.0
				2/12/2014	786	<0.03	0.00	0.03	1.0

Table E-1. Groundwater Transport Model Molybdenum Calibration Data

Well ID	Easting	Northing	Model Layer	Date	Model Time (days)	Measured Molybdenum Concentration (mg/L)	Simulated Molybdenum Concentration (mg/L)	Residual (mg/L)	Weight
				8/6/2014	1145	<0.03	0.00	0.03	1.0
				2/27/2015	1546	<0.03	0.00	0.03	1.0
0845-AI	487,833	1,537,280	1	2/19/2016	36	<0.03	0.00	0.03	1.0
				3/27/2017	228	<0.03	0.00	0.03	1.0
				8/9/2013	421	<0.03	0.00	0.03	1.0
				10/23/2014	611	<0.03	0.00	0.03	1.0
				3/29/2017	786	<0.03	0.00	0.03	1.0
				10/4/2017	1146	<0.03	0.00	0.03	1.0
				2/9/2013	1546	<0.03	0.00	0.03	1.0
0846-AI	484,730	1,537,219	1	11/16/2013	50	0.05	0.00	0.05	1.0
				2/12/2014	50	<0.03	0.00	0.03	1.0
				10/17/2014	303	<0.03	0.00	0.03	1.0
				2/27/2015	421	<0.03	0.00	0.03	1.0
				2/19/2016	611	<0.03	0.00	0.03	1.0
				7/8/2016	806	<0.03	0.00	0.03	1.0
				3/3/2017	911	<0.03	0.00	0.03	1.0
				11/9/2017	962	<0.03	0.00	0.03	1.0
				3/20/2013	1137	0.05	0.00	0.05	1.0
				10/17/2014	1546	<0.03	0.00	0.03	1.0
				3/25/2015	1681	<0.03	0.00	0.03	1.0
0852-AI	493,989	1,535,610	1	3/20/2013	911	<0.03	0.00	0.03	1.0
0862-AI	487,800	1,534,265	1	7/30/2014	124	<0.03	0.00	0.03	1.0
				4/23/2015	394	<0.03	0.00	0.03	1.0
				5/6/2015	528	<0.03	0.00	0.03	1.0
				6/17/2015	655	<0.03	0.00	0.03	1.0
				8/20/2015	865	<0.03	0.00	0.03	1.0
				9/30/2015	1222	<0.03	0.00	0.03	1.0
				1/12/2016	1312	<0.03	0.00	0.03	1.0
				2/19/2016	1393	<0.03	0.00	0.03	1.0
				4/6/2016	1431	<0.03	0.00	0.03	1.0
				7/24/2016	1540	<0.03	0.00	0.03	1.0
0864-AI	486,464	1,533,735	1	10/22/2016	-57	<0.03	0.00	0.03	1.0
				5/17/2017	962	<0.03	0.00	0.03	1.0
				7/11/2017	1317	<0.03	0.00	0.03	1.0

Table E-1. Groundwater Transport Model Molybdenum Calibration Data

Well ID	Easting	Northing	Model Layer	Date	Model Time (days)	Measured Molybdenum Concentration (mg/L)	Simulated Molybdenum Concentration (mg/L)	Residual (mg/L)	Weight
				12/13/2017	1690	<0.03	0.00	0.03	1.0
0865-AI	488,429	1,534,123	1	2/20/2013	655	<0.03	0.00	0.03	1.0
				4/25/2017	864	<0.03	0.00	0.03	1.0
				2/12/2013	962	<0.03	0.00	0.03	1.0
				8/9/2013	1215	<0.03	0.00	0.03	1.0
				2/12/2014	1312	<0.03	0.00	0.03	1.0
0866-AI	488,340	1,534,494	1	8/27/2014	123	<0.03	0.00	0.03	1.0
				3/13/2015	583	<0.03	0.00	0.03	1.0
				2/20/2016	620	<0.03	0.00	0.03	1.0
				3/14/2017	655	<0.03	0.00	0.03	1.0
				12/12/2013	660	<0.03	0.00	0.03	1.0
				10/23/2014	683	<0.03	0.00	0.03	1.0
				10/1/2015	722	<0.03	0.00	0.03	1.0
				2/26/2014	962	<0.03	0.00	0.03	1.0
				9/19/2014	1312	<0.03	0.00	0.03	1.0
				10/23/2014	1431	<0.03	0.00	0.03	1.0
				3/5/2015	1540	<0.03	0.00	0.03	1.0
				4/14/2016	1689	<0.03	0.00	0.03	1.0
0868-AI	491,033	1,534,848	1	10/7/2016	911	<0.03	0.01	0.02	1.0
0869-AI	486,073	1,533,251	1	3/3/2017	77	<0.03	0.00	0.03	1.0
				8/10/2017	169	<0.03	0.00	0.03	1.0
				10/8/2014	564	0.04	0.00	0.04	1.0
0881-AI	481,478	1,542,034	1	10/8/2014	39	0.05	0.04	0.01	1.0
				10/23/2014	303	<0.03	0.02	0.01	1.0
				12/11/2017	407	<0.03	0.01	0.02	1.0
				10/23/2014	603	0.04	0.01	0.03	1.0
				12/12/2013	787	<0.03	0.01	0.02	1.0
				10/14/2015	1144	<0.03	0.00	0.03	1.0
				4/5/2013	1514	<0.03	0.00	0.03	1.0
0882-AI	482,396	1,541,404	1	10/31/2013	43	<0.03	0.00	0.03	1.0
				3/28/2014	220	<0.03	0.00	0.03	1.0
				10/2/2014	407	<0.03	0.00	0.03	1.0
				4/10/2015	603	<0.03	0.00	0.03	1.0
				10/20/2015	787	<0.03	0.00	0.03	1.0

Table E-1. Groundwater Transport Model Molybdenum Calibration Data

Well ID	Easting	Northing	Model Layer	Date	Model Time (days)	Measured Molybdenum Concentration (mg/L)	Simulated Molybdenum Concentration (mg/L)	Residual (mg/L)	Weight
				8/24/2017	1144	<0.03	0.00	0.03	1.0
				10/27/2017	1534	<0.03	0.00	0.03	1.0
0884-AI	481,498	1,542,677	1	8/9/2013	39	<0.03	0.00	0.03	1.0
				12/16/2016	220	<0.03	0.00	0.03	1.0
				10/4/2017	407	<0.03	0.00	0.03	1.0
				3/21/2013	583	<0.03	0.00	0.03	1.0
				10/23/2014	787	<0.03	0.00	0.03	1.0
				10/1/2015	1144	<0.03	0.00	0.03	1.0
				12/16/2016	1546	<0.03	0.00	0.03	1.0
0885-AI	483,474	1,541,919	1	9/30/2016	220	<0.03	0.00	0.03	1.0
				9/19/2017	661	<0.03	0.01	0.02	1.0
				1/23/2013	1548	<0.03	0.01	0.02	1.0
				1/29/2014	1737	<0.03	0.02	0.01	1.0
0886-AI	482,487	1,542,327	1	2/5/2015	39	<0.03	0.00	0.03	1.0
				1/22/2016	319	<0.03	0.00	0.03	1.0
				1/24/2017	407	<0.03	0.00	0.03	1.0
				9/30/2016	654	<0.03	0.00	0.03	1.0
				3/22/2017	787	<0.03	0.00	0.03	1.0
				2/20/2013	1144	<0.03	0.00	0.03	1.0
				6/26/2014	1285	<0.03	0.00	0.03	1.0
				2/20/2015	1522	0.04	0.00	0.04	1.0
				3/22/2017	1773	0.05	0.00	0.05	1.0
0887-AI	482,469	1,543,063	1	2/20/2013	78	<0.03	0.00	0.03	1.0
				6/26/2014	654	0.06	0.00	0.06	1.0
				2/20/2015	814	<0.03	0.00	0.03	1.0
0888-AI	479,335	1,542,285	1	3/22/2017	78	<0.03	0.00	0.03	1.0
				1/23/2013	814	<0.03	0.02	0.01	1.0
				1/29/2014	1135	<0.03	0.02	0.01	1.0
				2/5/2015	1547	<0.03	0.01	0.02	1.0
				1/21/2016	1739	<0.03	0.01	0.02	1.0
0890-AI	480,088	1,541,365	1	1/16/2017	121	<0.03	0.01	0.02	1.0
				1/17/2013	576	0.04	0.01	0.03	1.0
				1/29/2014	842	<0.03	0.01	0.02	1.0
				2/4/2015	855	<0.03	0.01	0.02	1.0

Table E-1. Groundwater Transport Model Molybdenum Calibration Data

Well ID	Easting	Northing	Model Layer	Date	Model Time (days)	Measured Molybdenum Concentration (mg/L)	Simulated Molybdenum Concentration (mg/L)	Residual (mg/L)	Weight
				1/21/2016	897	<0.03	0.01	0.02	1.0
				1/16/2017	961	0.04	0.01	0.03	1.0
				1/22/2013	1002	<0.03	0.01	0.02	1.0
				1/29/2014	1106	<0.03	0.01	0.02	1.0
				2/5/2015	1145	<0.03	0.01	0.02	1.0
				1/22/2016	1192	<0.03	0.01	0.02	1.0
				1/24/2017	1300	<0.03	0.01	0.02	1.0
				1/17/2013	1391	<0.03	0.01	0.02	1.0
				1/28/2014	1597	<0.03	0.01	0.02	1.0
				2/5/2015	1652	<0.03	0.01	0.02	1.0
				1/21/2016	1807	<0.03	0.01	0.02	1.0
0891-AI	493,751	1,540,904	1	1/16/2017	51	0.32	0.00	0.56	1.0
				1/17/2013	1575	0.09	0.00	0.35	1.0
0893-AI	482,244	1,541,934	1	2/21/2013	43	<0.03	0.00	0.03	1.0
				1/29/2014	220	<0.03	0.00	0.03	1.0
				2/4/2015	407	<0.03	0.00	0.03	1.0
				1/21/2016	604	<0.03	0.00	0.03	1.0
				1/16/2017	802	0.04	0.00	0.04	1.0
				1/17/2013	1145	<0.03	0.00	0.03	1.0
				1/28/2014	1533	<0.03	0.00	0.03	1.0
0910-AI	481,150	1,528,800	1	2/5/2015	346	<0.03	0.00	0.03	1.0
				1/21/2016	660	<0.03	0.00	0.03	1.0
				1/16/2017	1003	<0.03	0.00	0.03	1.0
0920-AI	496,900	1,555,800	1	12/10/2013	422	<0.03	0.00	0.03	1.0
				10/11/2014	627	<0.03	0.00	0.03	1.0
				10/24/2015	660	<0.03	0.00	0.03	1.0
				12/20/2016	794	<0.03	0.00	0.03	1.0
				11/30/2017	1199	<0.03	0.00	0.03	1.0
				11/24/2013	1375	<0.03	0.00	0.03	1.0
				5/2/2017	1522	<0.03	0.00	0.03	1.0
				6/13/2015	1682	<0.03	0.00	0.03	1.0
0921-AI	495,800	1,555,400	1	5/2/2017	646	<0.03	0.00	0.11	1.0
				5/15/2013	646	<0.03	0.00	0.11	1.0
				6/26/2014	661	0.06	0.00	0.14	1.0

Table E-1. Groundwater Transport Model Molybdenum Calibration Data

Well ID	Easting	Northing	Model Layer	Date	Model Time (days)	Measured Molybdenum Concentration (mg/L)	Simulated Molybdenum Concentration (mg/L)	Residual (mg/L)	Weight
				2/6/2015	1805	<0.03	0.00	0.11	1.0
0922-AI	492,500	1,555,200	1	3/19/2016	661	<0.03	0.00	1.03	1.0
0935-AI	476,629	1,540,115	1	6/19/2013	346	<0.03	0.01	0.02	1.0
				11/24/2013	1017	<0.03	0.01	0.02	1.0
0994-AI	476,240	1,539,700	1	3/27/2014	94	0.07	0.06	0.01	1.0
				9/30/2014	303	<0.03	0.05	-0.02	1.0
				4/1/2015	451	<0.03	0.04	-0.01	1.0
				6/12/2015	639	<0.03	0.03	0.00	1.0
				10/2/2015	829	<0.03	0.03	0.00	1.0
				3/16/2016	1022	<0.03	0.02	0.01	1.0
				3/21/2017	1696	<0.03	0.01	0.02	1.0
				3/31/2017	1760	<0.03	0.01	0.02	1.0
0996-AI	477,989	1,537,621	1	9/20/2017	221	<0.03	0.00	0.15	1.0
				9/30/2014	1446	<0.03	0.00	0.15	1.0
				6/12/2015	1737	<0.03	0.00	0.43	1.0
0999-AI	480,187	1,524,230	1	10/31/2013	80	<0.03	0.00	0.03	1.0
				3/27/2014	660	<0.03	0.00	0.03	1.0
				9/30/2014	1003	<0.03	0.00	0.03	1.0
				4/1/2015	1445	<0.03	0.00	0.03	1.0
1F-AI	493,831	1,544,952	1	6/12/2015	1368	<0.03	1.06	-1.03	1.0
				10/2/2015	1722	<0.03	1.08	-1.05	1.0
1J-AI	493,695	1,541,986	1	3/16/2016	22	0.12	0.06	0.06	1.0
				9/30/2016	394	0.09	0.03	0.06	1.0
				3/31/2017	766	0.06	0.02	0.04	1.0
				11/1/2013	1117	0.10	0.01	0.09	1.0
				9/30/2014	1484	<0.03	0.01	0.02	1.0
1M-AI	493,133	1,541,327	1	6/12/2015	1368	0.10	0.08	0.02	1.0
				10/2/2015	1541	0.06	0.08	-0.02	1.0
1N-AI	494,396	1,543,100	1	3/31/2017	51	<0.03	0.00	1.03	1.0
				9/20/2017	542	<0.03	0.00	1.03	1.0
				11/15/2013	781	<0.03	0.00	1.03	1.0
				6/12/2014	1541	<0.03	0.00	1.03	1.0
1P-AI	493,924	1,541,902	1	9/10/2014	51	<0.03	0.00	0.32	1.0
				7/30/2015	542	0.06	0.00	0.35	1.0

Table E-1. Groundwater Transport Model Molybdenum Calibration Data

Well ID	Easting	Northing	Model Layer	Date	Model Time (days)	Measured Molybdenum Concentration (mg/L)	Simulated Molybdenum Concentration (mg/L)	Residual (mg/L)	Weight
				7/6/2016	781	0.04	0.00	0.33	1.0
				12/2/2016	1541	<0.03	0.00	0.32	1.0
1Q-AI	493,619	1,541,993	1	3/5/2013	22	0.27	0.00	0.29	1.0
				3/5/2013	393	0.30	0.00	0.40	1.0
				7/9/2013	766	0.11	0.04	0.07	1.0
				3/19/2014	1115	0.06	0.03	0.03	1.0
				7/11/2014	1476	0.11	0.00	0.11	1.0
1R-AI	493,623	1,542,071	1	7/24/2014	17	<0.03	0.00	0.77	1.0
				3/18/2015	393	<0.03	0.00	0.81	1.0
				7/16/2015	765	0.07	0.00	0.85	1.0
				3/16/2016	1115	<0.03	0.00	0.81	1.0
				7/12/2016	1476	0.05	0.00	0.83	1.0
1S-AI	493,614	1,541,920	1	3/20/2017	21	0.05	0.11	-0.06	1.0
				6/28/2017	394	0.09	0.04	0.05	1.0
				6/19/2014	766	0.06	0.03	0.03	1.0
				6/12/2015	1117	0.10	0.03	0.07	1.0
				5/2/2017	1484	<0.03	0.02	0.01	1.0
1T-AI	493,656	1,541,990	1	6/10/2015	16	0.05	0.08	-0.03	1.0
				6/27/2017	392	0.07	0.03	0.04	1.0
				2/12/2013	766	0.10	0.02	0.08	1.0
				5/2/2013	1115	0.11	0.02	0.09	1.0
				10/31/2013	1476	0.09	0.02	0.07	1.0
1U-AI	493,542	1,542,001	1	11/23/2013	17	0.84	0.00	1.69	1.0
				2/19/2014	51	1.20	0.00	2.06	1.0
				5/15/2014	393	0.19	0.00	1.06	1.0
				8/6/2014	765	0.16	0.29	-0.13	1.0
				12/12/2014	1115	0.11	0.00	0.59	1.0
				2/5/2015	1476	0.15	0.00	0.70	1.0
1V-AI	493,579	1,541,982	1	5/1/2015	16	2.21	0.00	2.83	1.0
				8/6/2015	393	0.14	0.00	0.81	1.0
				10/9/2015	766	0.12	0.09	0.03	1.0
				2/10/2016	1115	0.14	0.05	0.09	1.0
				5/18/2016	1476	0.09	0.00	0.15	1.0
AW-AI	488,015	1,540,235	1	11/2/2017	344	0.11	0.06	0.05	1.0

Table E-1. Groundwater Transport Model Molybdenum Calibration Data

Well ID	Easting	Northing	Model Layer	Date	Model Time (days)	Measured Molybdenum Concentration (mg/L)	Simulated Molybdenum Concentration (mg/L)	Residual (mg/L)	Weight
				11/23/2017	648	0.06	0.04	0.02	1.0
				2/12/2013	1027	0.06	0.03	0.03	1.0
				5/2/2013	1449	0.05	0.02	0.03	1.0
				10/31/2013	1794	0.06	0.02	0.04	1.0
B10-AI	491,133	1,542,517	1	2/5/2015	327	25.3	15.3	9.96	1.0
				5/1/2015	1582	18.5	8.72	9.78	1.0
B11-AI	491,329	1,542,517	1	8/6/2015	893	24.8	7.04	17.8	1.0
				10/9/2015	1582	11.4	4.26	7.14	1.0
B12-AI	488,915	1,542,524	1	2/10/2016	134	1.60	2.70	-1.10	1.0
				5/18/2016	542	2.41	1.65	0.76	1.0
				10/7/2016	767	1.78	0.35	1.43	1.0
				3/1/2017	1174	4.84	0.12	4.72	1.0
				5/3/2017	1777	2.14	0.15	1.99	1.0
B13-AI	490,223	1,541,841	1	8/8/2017	134	0.67	0.18	0.49	1.0
				10/12/2017	767	0.37	0.04	0.33	1.0
				11/23/2017	1547	0.44	0.04	0.40	1.0
B4-AI	489,942	1,542,471	1	6/12/2015	893	27.4	19.5	7.87	1.0
				6/12/2015	1582	29.2	4.14	25.1	1.0
B5-AI	490,141	1,542,474	1	6/12/2015	893	31.0	13.0	18.0	1.0
				6/10/2015	1581	18.6	5.04	13.6	1.0
B6-AI	490,341	1,542,478	1	6/27/2017	327	29.5	10.2	19.3	1.0
				3/6/2013	893	12.8	9.11	3.69	1.0
B7-AI	490,540	1,542,488	1	10/30/2013	170	0.53	10.6	-10.0	1.0
				3/19/2014	327	38.3	11.3	27.0	1.0
				9/16/2014	893	12.5	10.9	1.64	1.0
				3/18/2015	1582	26.3	9.86	16.4	1.0
B8-AI	490,734	1,542,488	1	9/26/2015	893	47.5	15.6	31.9	1.0
				9/26/2015	1582	22.7	14.0	8.67	1.0
B9-AI	490,935	1,542,514	1	3/16/2016	893	22.2	14.3	7.93	1.0
				9/20/2016	1581	20.7	13.1	7.56	1.0
B-AI	489,311	1,541,684	1	3/17/2017	534	0.04	0.00	0.04	1.0
				11/14/2017	872	<0.03	0.01	0.02	1.0
				3/6/2013	1541	<0.03	0.01	0.02	1.0
BC-AI	487,910	1,543,655	1	11/2/2013	534	0.09	0.12	-0.03	1.0

Table E-1. Groundwater Transport Model Molybdenum Calibration Data

Well ID	Easting	Northing	Model Layer	Date	Model Time (days)	Measured Molybdenum Concentration (mg/L)	Simulated Molybdenum Concentration (mg/L)	Residual (mg/L)	Weight
				3/20/2014	871	0.56	0.07	0.49	1.0
				9/16/2014	1638	0.07	0.05	0.02	1.0
C10-AI	491,629	1,542,182	1	3/18/2015	66	19.7	15.1	4.56	1.0
				8/7/2015	304	6.82	10.5	-3.73	1.0
				9/26/2015	451	16.2	8.91	7.29	1.0
				3/16/2016	638	4.71	7.00	-2.29	1.0
				9/20/2016	820	3.34	5.93	-2.59	1.0
				3/17/2017	892	9.98	5.51	4.47	1.0
				11/14/2017	1004	8.83	4.72	4.11	1.0
				3/6/2013	1170	15.1	3.88	11.2	1.0
				11/2/2013	1369	13.2	2.55	10.6	1.0
				3/19/2014	1550	18.5	0.67	17.8	1.0
C11-AI	491,844	1,542,376	1	9/19/2014	637	1.95	6.78	-4.83	1.0
				3/13/2015	892	13.7	5.08	8.62	1.0
				8/7/2015	1004	4.45	4.31	0.14	1.0
				3/16/2016	1369	7.32	2.57	4.75	1.0
				9/20/2016	1550	10.3	0.58	9.72	1.0
				3/17/2017	1723	8.77	0.15	8.62	1.0
C12-AI	492,029	1,542,375	1	11/14/2017	305	4.80	6.40	-1.60	1.0
				3/6/2013	892	13.6	3.05	10.5	1.0
				3/11/2015	1004	3.26	2.65	0.61	1.0
				8/19/2015	1369	2.95	1.61	1.34	1.0
				3/16/2016	1550	4.43	0.38	4.05	1.0
				3/20/2017	1723	4.14	0.11	4.03	1.0
C6-AI	491,142	1,541,533	1	8/14/2017	66	1.36	1.45	-0.09	1.0
				10/2/2015	304	2.71	1.54	1.17	1.0
				12/22/2016	451	1.36	1.43	-0.07	1.0
				9/20/2017	638	0.71	1.18	-0.47	1.0
				1/16/2013	820	1.04	1.08	-0.04	1.0
				11/1/2013	892	1.36	1.13	0.23	1.0
				1/28/2014	1005	0.75	1.20	-0.45	1.0
				9/18/2014	1170	2.44	1.14	1.30	1.0
				2/5/2015	1540	1.10	0.78	0.32	1.0
				6/12/2015	1550	1.30	0.77	0.53	1.0

Table E-1. Groundwater Transport Model Molybdenum Calibration Data

Well ID	Easting	Northing	Model Layer	Date	Model Time (days)	Measured Molybdenum Concentration (mg/L)	Simulated Molybdenum Concentration (mg/L)	Residual (mg/L)	Weight
				7/17/2015	1723	3.70	0.71	2.99	1.0
C7-AI	491,280	1,541,734	1	1/19/2016	638	30.4	5.26	25.1	1.0
				1/6/2017	892	18.2	4.35	13.8	1.0
				3/31/2017	1005	18.0	4.29	13.7	1.0
				11/7/2017	1550	5.53	1.97	3.56	1.0
C8-AI	491,415	1,541,906	1	1/16/2013	66	21.6	17.2	4.37	1.0
				11/1/2013	303	9.99	12.2	-2.21	1.0
				1/28/2014	451	19.6	10.1	9.55	1.0
				9/18/2014	638	1.96	7.81	-5.85	1.0
				6/12/2015	820	19.5	6.77	12.7	1.0
				7/17/2015	892	5.80	6.46	-0.66	1.0
				1/19/2016	1005	2.15	5.87	-3.72	1.0
				1/6/2017	1170	8.21	5.03	3.18	1.0
				3/31/2017	1369	1.02	3.39	-2.37	1.0
C9-AI	491,545	1,542,075	1	7/18/2017	1550	5.47	2.20	3.27	1.0
				11/7/2017	304	12.4	11.7	0.74	1.0
				11/7/2013	638	18.5	7.93	10.6	1.0
				1/16/2013	892	16.2	6.53	9.67	1.0
				1/28/2014	1005	18.4	5.79	12.6	1.0
				9/18/2014	1550	11.4	1.62	9.78	1.0
CW44-AI	488,891	1,535,048	1	2/5/2015	1723	4.13	0.98	3.15	1.0
				3/27/2015	319	<0.03	0.00	0.03	1.0
				5/13/2015	528	<0.03	0.01	0.02	1.0
				8/27/2015	618	<0.03	0.01	0.02	1.0
				8/17/2017	940	<0.03	0.01	0.02	1.0
				2/21/2013	1283	<0.03	0.02	0.01	1.0
D1-AI	489,615	1,542,140	1	4/1/2015	1432	<0.03	0.02	0.01	1.0
				6/12/2015	64	2.70	1.93	0.77	1.0
				3/22/2017	64	2.75	1.93	0.82	1.0
				11/9/2017	189	2.25	1.59	0.66	1.0
				1/16/2013	443	2.88	1.09	1.79	1.0
				2/11/2014	556	2.92	0.97	1.95	1.0
				1/29/2015	569	2.60	0.94	1.66	1.0
				2/6/2015	806	4.50	0.74	3.76	1.0

Table E-1. Groundwater Transport Model Molybdenum Calibration Data

Well ID	Easting	Northing	Model Layer	Date	Model Time (days)	Measured Molybdenum Concentration (mg/L)	Simulated Molybdenum Concentration (mg/L)	Residual (mg/L)	Weight
				1/26/2016	927	4.47	0.81	3.66	1.0
				1/17/2017	1170	2.16	0.75	1.41	1.0
				11/13/2017	1288	2.05	0.48	1.57	1.0
				5/16/2013	1539	0.94	0.19	0.75	1.0
				5/29/2014	1639	1.33	0.17	1.16	1.0
D2-AI	492,107	1,542,641	1	5/20/2015	534	40.3	3.78	36.5	1.0
DA3-AI	489,390	1,542,664	1	5/3/2017	893	18.9	8.39	10.5	1.0
				5/29/2014	1582	12.4	1.67	10.7	1.0
DC-AI	487,060	1,543,646	1	5/20/2015	891	<0.03	0.05	-0.02	1.0
				5/3/2017	1638	<0.03	0.05	-0.02	1.0
DD2-AI	489,251	1,547,439	1	6/12/2015	42	<0.03	0.00	0.03	1.0
				1/16/2013	122	<0.03	0.00	0.03	1.0
				1/16/2013	304	0.12	0.00	0.12	1.0
				11/24/2013	326	<0.03	0.00	0.03	1.0
				6/12/2015	415	<0.03	0.00	0.03	1.0
				1/26/2016	500	<0.03	0.00	0.03	1.0
				1/24/2017	582	<0.03	0.00	0.03	1.0
				3/23/2017	710	<0.03	0.00	0.03	1.0
				5/1/2013	766	0.08	0.00	0.08	1.0
				10/26/2017	851	<0.03	0.00	0.03	1.0
				5/1/2013	947	<0.03	0.00	0.03	1.0
				11/6/2013	1011	<0.03	0.00	0.03	1.0
				5/29/2014	1135	<0.03	0.00	0.03	1.0
				5/13/2015	1233	<0.03	0.00	0.03	1.0
				10/21/2015	1377	<0.03	0.00	0.03	1.0
				10/27/2016	1520	<0.03	0.00	0.03	1.0
				6/1/2017	1582	<0.03	0.00	0.03	1.0
				5/1/2013	1680	<0.03	0.00	0.03	1.0
				11/6/2013	1745	<0.03	0.00	0.03	1.0
				5/29/2014	1766	<0.03	0.00	0.03	1.0
				4/15/2015	1787	<0.03	0.00	0.03	1.0
DD-AI	488,943	1,546,989	1	11/4/2015	42	<0.03	0.00	0.03	1.0
				6/2/2017	122	<0.03	0.00	0.03	1.0
				10/26/2017	304	<0.03	0.00	0.03	1.0

Table E-1. Groundwater Transport Model Molybdenum Calibration Data

Well ID	Easting	Northing	Model Layer	Date	Model Time (days)	Measured Molybdenum Concentration (mg/L)	Simulated Molybdenum Concentration (mg/L)	Residual (mg/L)	Weight
				11/24/2013	326	<0.03	0.00	0.03	1.0
				6/12/2015	407	<0.03	0.00	0.03	1.0
				3/22/2017	500	<0.03	0.00	0.03	1.0
				5/29/2014	582	<0.03	0.00	0.03	1.0
				5/13/2015	710	<0.03	0.00	0.03	1.0
				5/3/2017	766	<0.03	0.00	0.03	1.0
				1/17/2013	851	<0.03	0.00	0.03	1.0
				2/11/2014	947	<0.03	0.00	0.03	1.0
				2/6/2015	1011	<0.03	0.00	0.03	1.0
				1/29/2016	1135	<0.03	0.00	0.03	1.0
				1/16/2017	1233	<0.03	0.00	0.03	1.0
				11/20/2014	1376	<0.03	0.00	0.03	1.0
				7/29/2015	1520	<0.03	0.00	0.03	1.0
				8/3/2017	1583	<0.03	0.00	0.03	1.0
				11/13/2014	1680	<0.03	0.00	0.03	1.0
				7/28/2015	1745	<0.03	0.00	0.03	1.0
				3/29/2017	1787	<0.03	0.00	0.03	1.0
DQ-AI	491,005	1,542,591	1	5/2/2013	893	0.88	8.54	-7.66	1.0
DR-AI	489,966	1,542,884	1	11/13/2014	893	18.7	21.9	-3.16	1.0
DT-AI	489,293	1,542,871	1	7/28/2015	893	5.37	10.6	-5.21	1.0
DZ-AI	491,501	1,542,834	1	11/26/2014	890	46.7	5.24	41.5	1.0
				11/26/2014	1638	36.6	7.71	28.9	1.0
F-AI	489,554	1,539,908	1	6/10/2015	64	<0.03	0.00	0.03	1.0
				11/26/2014	303	<0.03	0.00	0.03	1.0
				5/16/2015	443	<0.03	0.00	0.03	1.0
				11/13/2014	624	<0.03	0.00	0.03	1.0
				5/15/2015	807	<0.03	0.00	0.03	1.0
				11/13/2014	998	<0.03	0.00	0.03	1.0
				5/16/2015	998	<0.03	0.00	0.03	1.0
				11/13/2014	1171	<0.03	0.00	0.03	1.0
				5/16/2015	1359	<0.03	0.00	0.03	1.0
				11/9/2017	1536	<0.03	0.00	0.03	1.0
FB-AI	488,857	1,540,417	1	6/24/2015	1778	<0.03	0.00	0.03	1.0
				12/11/2017	64	<0.03	0.00	0.03	1.0

Table E-1. Groundwater Transport Model Molybdenum Calibration Data

Well ID	Easting	Northing	Model Layer	Date	Model Time (days)	Measured Molybdenum Concentration (mg/L)	Simulated Molybdenum Concentration (mg/L)	Residual (mg/L)	Weight
				5/2/2013	305	<0.03	0.00	0.03	1.0
				11/20/2014	444	<0.03	0.00	0.03	1.0
				6/10/2015	624	<0.03	0.00	0.03	1.0
				12/11/2017	807	<0.03	0.00	0.03	1.0
				11/20/2014	949	<0.03	0.00	0.03	1.0
				6/10/2015	998	<0.03	0.00	0.03	1.0
				7/29/2015	1171	<0.03	0.00	0.03	1.0
				11/26/2014	1359	<0.03	0.00	0.03	1.0
				6/10/2015	1536	<0.03	0.00	0.03	1.0
				11/23/2013	1778	<0.03	0.00	0.03	1.0
GH-AI	489,509	1,538,807	1	11/19/2014	64	<0.03	0.00	0.03	1.0
				7/28/2015	305	<0.03	0.00	0.03	1.0
				12/12/2017	443	<0.03	0.00	0.03	1.0
				5/15/2015	627	<0.03	0.00	0.03	1.0
				11/26/2014	801	<0.03	0.00	0.03	1.0
				6/10/2015	949	<0.03	0.00	0.03	1.0
				6/10/2015	1170	<0.03	0.00	0.03	1.0
				12/12/2017	1359	<0.03	0.00	0.03	1.0
				11/19/2014	1536	<0.03	0.00	0.03	1.0
				5/15/2015	1778	<0.03	0.00	0.03	1.0
GN-AI	490,944	1,538,602	1	5/2/2013	65	<0.03	0.00	0.03	1.0
				11/19/2014	800	<0.03	0.00	0.03	1.0
				7/28/2015	961	<0.03	0.00	0.03	1.0
				11/19/2014	1171	<0.03	0.00	0.03	1.0
				7/28/2015	1539	<0.03	0.00	0.03	1.0
				5/19/2015	1686	<0.03	0.00	0.03	1.0
GV-AI	491,428	1,537,701	1	5/19/2015	1005	<0.03	0.00	0.03	1.0
				5/15/2015	1451	<0.03	0.00	0.03	1.0
				11/20/2014	1723	<0.03	0.00	0.03	1.0
K10-AI	491,638	1,541,305	1	7/28/2015	15	0.81	0.91	-0.10	1.0
				9/30/2015	305	1.35	1.24	0.11	1.0
				9/30/2016	393	1.27	1.16	0.11	1.0
				9/26/2017	625	1.05	0.85	0.20	1.0
				6/12/2015	766	6.97	0.84	6.13	1.0

Table E-1. Groundwater Transport Model Molybdenum Calibration Data

Well ID	Easting	Northing	Model Layer	Date	Model Time (days)	Measured Molybdenum Concentration (mg/L)	Simulated Molybdenum Concentration (mg/L)	Residual (mg/L)	Weight
				9/30/2015	892	3.03	0.97	2.06	1.0
				9/30/2016	927	6.13	0.99	5.14	1.0
				9/26/2017	1113	3.32	1.02	2.30	1.0
				10/1/2015	1466	4.63	0.68	3.95	1.0
				9/26/2017	1550	1.36	0.56	0.80	1.0
				2/12/2013	1771	2.62	0.42	2.20	1.0
K11-AI	491,490	1,541,325	1	4/20/2013	15	1.01	0.79	0.22	1.0
				7/9/2013	305	1.03	0.90	0.13	1.0
				11/1/2013	393	0.93	0.91	0.02	1.0
				2/12/2014	625	1.01	0.72	0.29	1.0
				4/22/2014	892	1.26	0.81	0.45	1.0
				7/11/2014	927	1.27	0.84	0.43	1.0
				7/24/2014	1113	1.12	0.99	0.13	1.0
				2/4/2015	1466	1.20	0.74	0.46	1.0
				4/3/2015	1550	1.36	0.63	0.73	1.0
				7/17/2015	1659	2.21	0.54	1.67	1.0
				10/9/2015	1771	3.92	0.47	3.45	1.0
K2-AI	491,587	1,540,736	1	2/10/2016	310	0.08	0.05	0.03	1.0
K4-AI	492,371	1,541,211	1	4/13/2016	15	1.57	1.08	0.49	1.0
				7/10/2016	393	0.64	0.39	0.25	1.0
				10/21/2016	626	1.42	0.26	1.16	1.0
				3/1/2017	766	1.58	0.21	1.37	1.0
				5/1/2017	892	1.21	0.17	1.04	1.0
				7/18/2017	927	0.71	0.16	0.55	1.0
				10/26/2017	1116	0.29	0.12	0.17	1.0
				11/28/2017	1296	0.82	0.07	0.75	1.0
				2/9/2013	1466	1.19	0.05	1.14	1.0
				7/9/2013	1550	1.32	0.05	1.27	1.0
				2/13/2014	1659	1.68	0.05	1.63	1.0
				6/17/2014	1770	1.10	0.04	1.06	1.0
K5-AI	491,935	1,541,269	1	3/5/2015	15	1.41	1.25	0.16	1.0
				5/22/2015	305	1.83	1.15	0.68	1.0
				2/16/2016	393	1.86	1.09	0.77	1.0
				7/13/2016	625	2.37	0.88	1.49	1.0

Table E-1. Groundwater Transport Model Molybdenum Calibration Data

Well ID	Easting	Northing	Model Layer	Date	Model Time (days)	Measured Molybdenum Concentration (mg/L)	Simulated Molybdenum Concentration (mg/L)	Residual (mg/L)	Weight
				3/1/2017	892	1.57	0.79	0.78	1.0
				6/28/2017	927	1.72	0.78	0.94	1.0
				2/26/2013	1113	2.46	0.69	1.77	1.0
				10/4/2014	1296	3.02	0.52	2.50	1.0
				7/2/2015	1466	1.19	0.36	0.83	1.0
				10/3/2014	1550	1.47	0.31	1.16	1.0
				7/2/2015	1659	3.96	0.26	3.70	1.0
				7/5/2017	1771	4.07	0.22	3.85	1.0
K7-AI	492,237	1,541,232	1	12/10/2013	15	0.87	0.81	0.06	1.0
				10/11/2014	305	0.78	0.73	0.05	1.0
				10/24/2015	393	0.79	0.63	0.16	1.0
				12/20/2016	625	0.71	0.44	0.27	1.0
				11/30/2017	766	0.71	0.37	0.34	1.0
				9/5/2013	892	0.57	0.30	0.27	1.0
				7/24/2014	927	0.68	0.29	0.39	1.0
				7/17/2015	1113	1.05	0.20	0.85	1.0
				7/19/2017	1296	0.53	0.10	0.43	1.0
				2/26/2013	1466	2.30	0.06	2.24	1.0
				8/6/2015	1550	1.38	0.06	1.32	1.0
				7/19/2016	1659	1.58	0.05	1.53	1.0
				2/10/2017	1770	0.64	0.05	0.59	1.0
K8-AI	492,081	1,541,250	1	7/19/2017	15	1.32	1.11	0.21	1.0
				2/26/2013	305	1.33	0.95	0.38	1.0
				7/24/2014	393	0.73	0.89	-0.16	1.0
				9/30/2014	625	1.56	0.70	0.86	1.0
				8/6/2015	892	0.86	0.56	0.30	1.0
				7/19/2016	927	0.90	0.54	0.36	1.0
				3/21/2017	1117	0.63	0.41	0.22	1.0
				7/19/2017	1296	1.39	0.28	1.11	1.0
				7/24/2014	1466	1.79	0.18	1.61	1.0
				10/3/2014	1550	2.07	0.15	1.92	1.0
				7/17/2015	1659	2.28	0.13	2.15	1.0
				7/20/2017	1770	2.84	0.11	2.73	1.0
K9-AI	491,787	1,541,287	1	3/6/2013	15	3.20	1.80	1.40	1.0

Table E-1. Groundwater Transport Model Molybdenum Calibration Data

Well ID	Easting	Northing	Model Layer	Date	Model Time (days)	Measured Molybdenum Concentration (mg/L)	Simulated Molybdenum Concentration (mg/L)	Residual (mg/L)	Weight
				9/5/2013	305	2.64	1.26	1.38	1.0
				10/3/2014	393	2.67	1.16	1.51	1.0
				4/1/2015	625	4.06	0.90	3.16	1.0
				8/28/2015	766	2.14	0.85	1.29	1.0
				3/19/2016	892	1.87	0.91	0.96	1.0
				3/21/2017	927	3.26	0.91	2.35	1.0
				3/6/2013	1113	4.10	0.88	3.22	1.0
				9/5/2013	1296	1.37	0.73	0.64	1.0
				10/3/2014	1466	1.16	0.55	0.61	1.0
				4/1/2015	1550	1.34	0.46	0.88	1.0
				3/19/2016	1771	2.66	0.34	2.32	1.0
KF-AI	491,169	1,540,870	1	3/21/2017	932	0.06	0.05	0.01	1.0
				2/26/2013	1547	0.07	0.02	0.05	1.0
L10-AI	492,310	1,539,250	1	9/30/2014	722	0.50	0.46	0.04	1.0
				5/13/2015	1019	0.42	0.09	0.33	1.0
				10/16/2015	1396	0.43	0.09	0.34	1.0
				5/11/2016	1581	0.54	0.09	0.45	1.0
				10/27/2016	1756	0.40	0.10	0.30	1.0
L5-AI	492,730	1,539,946	1	5/2/2017	722	0.42	0.27	0.15	1.0
				6/28/2017	1052	0.34	0.15	0.19	1.0
				7/18/2017	1581	0.39	0.15	0.24	1.0
				10/25/2017	1756	0.31	0.15	0.16	1.0
L6-AI	493,110	1,540,526	1	2/26/2013	722	0.24	0.35	-0.11	1.0
				9/30/2014	1019	0.26	0.33	-0.07	1.0
				7/17/2015	1396	0.29	0.33	-0.04	1.0
				7/16/2016	1581	0.35	0.33	0.02	1.0
				2/10/2017	1756	0.31	0.33	-0.02	1.0
L7-AI	492,842	1,540,113	1	7/19/2017	722	0.40	0.25	0.15	1.0
				2/26/2013	1052	0.39	0.04	0.35	1.0
				9/30/2014	1581	0.39	0.04	0.35	1.0
				7/17/2015	1756	0.19	0.05	0.14	1.0
L8-AI	492,621	1,539,773	1	7/19/2016	722	0.28	0.33	-0.05	1.0
				2/10/2017	1019	0.45	0.06	0.39	1.0
				7/19/2017	1396	0.78	0.06	0.72	1.0

Table E-1. Groundwater Transport Model Molybdenum Calibration Data

Well ID	Easting	Northing	Model Layer	Date	Model Time (days)	Measured Molybdenum Concentration (mg/L)	Simulated Molybdenum Concentration (mg/L)	Residual (mg/L)	Weight
				7/9/2013	1581	0.47	0.06	0.41	1.0
L9-AI	492,463	1,539,509	1	3/27/2015	722	0.54	0.56	-0.02	1.0
				6/12/2015	1052	0.31	0.45	-0.14	1.0
				7/20/2017	1581	0.43	0.35	0.08	1.0
				2/28/2013	1756	0.32	0.36	-0.04	1.0
L-AI	492,150	1,538,970	1	9/5/2013	722	0.62	0.29	0.33	1.0
				7/24/2014	1396	0.46	0.18	0.28	1.0
				3/20/2015	1581	0.52	0.18	0.34	1.0
				8/19/2015	1756	0.47	0.19	0.28	1.0
M10-AI	486,723	1,543,677	1	9/26/2015	135	<0.03	0.00	0.03	1.0
				2/11/2016	1172	<0.03	0.01	0.02	1.0
				9/20/2016	1543	<0.03	0.01	0.02	1.0
M16-AI	485,112	1,543,252	1	3/2/2017	1005	0.14	0.01	0.13	1.0
				11/14/2017	1722	0.14	0.02	0.12	1.0
M3-AI	489,151	1,542,805	1	2/28/2013	327	9.20	5.83	3.37	1.0
				10/11/2014	893	9.49	5.53	3.96	1.0
				3/27/2015	1542	3.51	1.88	1.63	1.0
M5-AI	489,080	1,542,360	1	8/19/2015	337	0.15	0.29	-0.14	1.0
				3/16/2016	940	<0.03	0.27	-0.24	1.0
M6-AI	486,674	1,543,097	1	3/21/2017	134	1.58	1.19	0.39	1.0
				7/19/2017	792	2.06	0.34	1.72	1.0
				8/14/2017	1543	1.71	0.14	1.57	1.0
M7-AI	486,523	1,542,790	1	3/5/2013	79	1.22	1.04	0.18	1.0
				11/22/2013	792	0.95	0.34	0.61	1.0
				10/1/2014	1172	1.02	0.21	0.81	1.0
M9-AI	486,699	1,543,310	1	6/30/2017	52	0.67	0.79	-0.12	1.0
				3/5/2013	327	7.02	0.51	6.51	1.0
				10/3/2014	352	2.09	0.49	1.60	1.0
				6/30/2017	638	3.55	0.34	3.21	1.0
				2/26/2013	793	0.87	0.29	0.58	1.0
				10/4/2014	893	1.16	0.26	0.90	1.0
				3/31/2015	1005	1.89	0.24	1.65	1.0
				8/25/2016	1172	0.77	0.20	0.57	1.0
ML-AI	486,691	1,543,902	1	3/20/2017	135	<0.03	0.00	0.03	1.0

Table E-1. Groundwater Transport Model Molybdenum Calibration Data

Well ID	Easting	Northing	Model Layer	Date	Model Time (days)	Measured Molybdenum Concentration (mg/L)	Simulated Molybdenum Concentration (mg/L)	Residual (mg/L)	Weight
				8/17/2017	1172	<0.03	0.00	0.03	1.0
				2/28/2013	1543	<0.03	0.00	0.03	1.0
MO-AI	485,518	1,543,620	1	10/3/2014	63	<0.03	0.00	0.03	1.0
				7/2/2015	305	<0.03	0.00	0.03	1.0
				11/28/2017	443	<0.03	0.00	0.03	1.0
				7/1/2015	801	<0.03	0.00	0.03	1.0
				6/30/2017	1019	0.04	0.00	0.04	1.0
				11/27/2013	1170	0.08	0.00	0.08	1.0
				10/1/2014	1395	<0.03	0.00	0.03	1.0
				3/11/2015	1536	<0.03	0.00	0.03	1.0
MQ-AI	486,326	1,543,173	1	8/19/2015	52	0.17	0.38	-0.21	1.0
				3/17/2016	327	0.99	0.68	0.31	1.0
				3/20/2017	638	0.41	1.00	-0.59	1.0
				8/11/2017	792	0.32	1.02	-0.70	1.0
				11/15/2013	893	0.38	0.99	-0.61	1.0
				4/16/2014	1005	0.32	0.88	-0.56	1.0
				9/11/2014	1172	0.34	0.77	-0.43	1.0
				5/13/2016	1543	0.31	0.60	-0.29	1.0
MR-AI	483,574	1,542,609	1	10/22/2016	1722	0.33	0.52	-0.19	1.0
				5/3/2017	799	0.05	0.02	0.03	1.0
				10/3/2014	834	0.05	0.02	0.03	1.0
				6/30/2017	950	0.06	0.02	0.04	1.0
				5/11/2013	1170	0.08	0.03	0.05	1.0
				6/12/2014	1348	0.06	0.04	0.02	1.0
				7/10/2013	1539	0.05	0.05	0.00	1.0
				5/15/2014	1581	0.06	0.05	0.01	1.0
				11/15/2013	1683	0.06	0.05	0.01	1.0
MS-AI	485,570	1,542,607	1	6/12/2014	1746	0.06	0.06	0.00	1.0
				9/11/2014	121	0.05	0.07	-0.02	1.0
				5/13/2016	327	0.17	0.08	0.09	1.0
				2/9/2013	1278	<0.03	0.04	-0.01	1.0
				7/9/2013	1548	<0.03	0.04	-0.01	1.0
				2/13/2014	1660	<0.03	0.04	-0.01	1.0
				2/13/2014	1795	<0.03	0.03	0.00	1.0

Table E-1. Groundwater Transport Model Molybdenum Calibration Data

Well ID	Easting	Northing	Model Layer	Date	Model Time (days)	Measured Molybdenum Concentration (mg/L)	Simulated Molybdenum Concentration (mg/L)	Residual (mg/L)	Weight
MT-AI	483,531	1,543,221	1	6/17/2014	136	<0.03	0.00	0.03	1.0
MV-AI	484,418	1,542,618	1	3/5/2015	135	0.06	0.07	-0.01	1.0
				3/5/2015	813	0.04	0.14	-0.10	1.0
MW-AI	486,346	1,543,802	1	5/22/2015	135	<0.03	0.00	0.03	1.0
				2/16/2016	1543	<0.03	0.00	0.03	1.0
MX-AI	486,244	1,541,287	1	7/12/2016	135	<0.03	0.00	0.03	1.0
				3/1/2017	799	<0.03	0.00	0.03	1.0
				11/15/2013	960	<0.03	0.00	0.03	1.0
				6/12/2014	1170	<0.03	0.00	0.03	1.0
				6/10/2015	1539	<0.03	0.00	0.03	1.0
				7/6/2016	1683	<0.03	0.00	0.03	1.0
				8/24/2017	1777	<0.03	0.00	0.03	1.0
MY-AI	486,213	1,542,200	1	11/20/2013	1446	<0.03	0.00	0.03	1.0
				6/19/2014	1777	<0.03	0.00	0.03	1.0
MZ-AI	486,757	1,543,485	1	10/4/2014	135	<0.03	0.06	-0.03	1.0
				7/1/2015	792	<0.03	0.11	-0.08	1.0
				7/5/2017	1172	<0.03	0.10	-0.07	1.0
				12/10/2013	1543	<0.03	0.09	-0.06	1.0
NB-AI	491,296	1,545,000	1	10/11/2014	970	33.6	22.6	11.0	1.0
				10/24/2015	1693	45.9	17.1	28.8	1.0
NC-AI	491,282	1,545,220	1	12/20/2016	834	<0.03	10.3	-10.3	1.0
				11/30/2017	969	0.20	12.0	-11.8	1.0
				10/2/2014	1688	0.11	9.48	-9.37	1.0
ND-AI	494,872	1,545,927	1	7/1/2015	337	<0.03	0.00	0.03	1.0
				6/30/2017	816	<0.03	0.00	0.03	1.0
				6/25/2013	862	<0.03	0.00	0.03	1.0
O-AI	492,725	1,545,060	1	11/27/2013	969	<0.03	7.34	-7.31	1.0
				10/1/2014	1689	<0.03	8.88	-8.85	1.0
P2-AI	490,912	1,546,555	1	6/29/2017	52	<0.03	0.00	0.03	1.0
				10/23/2017	820	<0.03	0.00	0.03	1.0
				2/28/2013	1542	<0.03	0.00	0.03	1.0
P3-AI	490,785	1,546,159	1	7/2/2015	52	<0.03	0.00	0.03	1.0
				8/7/2015	820	<0.03	0.00	0.03	1.0
				7/31/2017	1542	<0.03	0.00	0.03	1.0

Table E-1. Groundwater Transport Model Molybdenum Calibration Data

Well ID	Easting	Northing	Model Layer	Date	Model Time (days)	Measured Molybdenum Concentration (mg/L)	Simulated Molybdenum Concentration (mg/L)	Residual (mg/L)	Weight
P4-AI	491,899	1,546,504	1	2/26/2013	52	<0.03	0.00	0.03	1.0
				10/4/2014	641	<0.03	0.00	0.03	1.0
				7/2/2015	820	<0.03	0.00	0.03	1.0
				12/12/2017	1542	<0.03	0.00	0.03	1.0
P-AI	491,058	1,546,691	1	2/12/2013	127	<0.03	0.00	0.03	1.0
				2/28/2013	309	<0.03	0.00	0.03	1.0
				11/5/2013	500	<0.03	0.00	0.03	1.0
				2/12/2014	869	<0.03	0.00	0.03	1.0
				9/5/2014	1023	<0.03	0.00	0.03	1.0
				7/2/2015	1232	<0.03	0.00	0.03	1.0
				8/7/2015	1717	<0.03	0.00	0.03	1.0
				2/11/2016	1759	<0.03	0.00	0.03	1.0
Q-AI	492,153	1,548,693	1	9/27/2016	134	<0.03	0.00	0.03	1.0
				3/21/2017	816	<0.03	0.00	0.03	1.0
				8/10/2017	851	<0.03	0.00	0.03	1.0
				11/15/2013	1234	<0.03	0.00	0.03	1.0
				6/12/2014	1375	<0.03	0.00	0.03	1.0
				9/10/2014	1395	<0.03	0.00	0.03	1.0
				7/30/2015	1542	<0.03	0.00	0.03	1.0
				7/6/2016	1583	<0.03	0.00	0.03	1.0
				12/2/2016	1612	<0.03	0.00	0.03	1.0
R-AI	494,514	1,550,372	1	3/7/2013	1799	<0.03	0.00	0.03	1.0
				6/18/2013	134	<0.03	0.00	0.03	1.0
				11/15/2013	816	<0.03	0.00	0.03	1.0
				11/14/2014	862	<0.03	0.00	0.03	1.0
				12/24/2014	1233	<0.03	0.00	0.03	1.0
				4/1/2015	1395	<0.03	0.00	0.03	1.0
				4/1/2015	1583	<0.03	0.00	0.03	1.0
				8/20/2015	1798	<0.03	0.00	0.03	1.0
S11-AI	488,150	1,544,793	1	3/5/2016	337	0.05	0.00	0.05	1.0
				8/27/2016	1476	0.04	0.00	0.04	1.0
				3/24/2017	1746	<0.03	0.00	0.03	1.0
S12-AI	488,628	1,543,297	1	8/15/2017	16	1.97	1.30	0.67	1.0
				12/4/2013	406	1.93	1.00	0.93	1.0

Table E-1. Groundwater Transport Model Molybdenum Calibration Data

Well ID	Easting	Northing	Model Layer	Date	Model Time (days)	Measured Molybdenum Concentration (mg/L)	Simulated Molybdenum Concentration (mg/L)	Residual (mg/L)	Weight
				10/11/2014	766	10.8	1.07	9.73	1.0
S1-AI	488,401	1,543,288	1	7/30/2015	830	0.57	1.03	-0.46	1.0
S2-AI	488,299	1,543,127	1	12/12/2017	15	5.85	4.51	1.34	1.0
				5/2/2013	190	5.01	4.21	0.80	1.0
				8/8/2013	386	4.43	3.72	0.71	1.0
				10/1/2014	557	3.92	3.10	0.82	1.0
				2/21/2015	760	4.66	2.86	1.80	1.0
				8/28/2015	927	3.18	2.54	0.64	1.0
				12/17/2016	1114	2.49	2.29	0.20	1.0
				8/16/2017	1286	5.41	1.80	3.61	1.0
				10/24/2017	1473	3.82	1.22	2.60	1.0
				5/11/2013	1659	3.73	1.10	2.63	1.0
S3-AI	488,714	1,542,857	1	10/1/2014	831	5.69	1.12	4.57	1.0
				2/21/2015	940	7.52	1.22	6.30	1.0
				9/1/2015	1660	4.25	0.51	3.74	1.0
S4-AI	488,359	1,543,344	1	10/24/2017	64	0.65	0.85	-0.20	1.0
				5/11/2013	190	0.55	0.87	-0.32	1.0
				10/1/2014	443	0.52	0.89	-0.37	1.0
				2/21/2015	557	0.48	0.89	-0.41	1.0
				9/1/2015	568	0.48	0.89	-0.41	1.0
				8/16/2017	927	0.52	1.00	-0.48	1.0
				10/24/2017	1124	0.44	1.05	-0.61	1.0
				5/11/2013	1170	0.46	1.02	-0.56	1.0
				10/1/2014	1286	0.55	0.89	-0.34	1.0
				4/1/2015	1533	0.28	0.63	-0.35	1.0
				8/29/2015	1659	0.30	0.61	-0.31	1.0
				12/17/2016	1777	0.31	0.60	-0.29	1.0
S5R-AI	488,938	1,543,150	1	8/16/2017	327	34.7	14.3	20.4	1.0
				5/15/2013	893	44.9	12.6	32.3	1.0
				10/1/2014	1542	0.63	3.65	-3.02	1.0
SA-AI	488,811	1,543,122	1	4/1/2015	838	72.5	5.86	66.6	1.0
				8/29/2015	893	73.4	6.68	66.7	1.0
				5/19/2016	1114	2.46	6.55	-4.09	1.0
				12/1/2016	1124	34.8	6.17	28.6	1.0

Table E-1. Groundwater Transport Model Molybdenum Calibration Data

Well ID	Easting	Northing	Model Layer	Date	Model Time (days)	Measured Molybdenum Concentration (mg/L)	Simulated Molybdenum Concentration (mg/L)	Residual (mg/L)	Weight
				12/15/2016	1541	66.7	1.72	65.0	1.0
				2/10/2017	1777	43.2	1.50	41.7	1.0
SB-AI	488,811	1,543,371	1	5/3/2017	893	85.2	10.2	75.0	1.0
				8/16/2017	1541	79.8	2.72	77.1	1.0
				11/29/2017	1773	73.3	2.70	70.6	1.0
SE6-AI	488,615	1,543,244	1	10/1/2014	16	0.13	1.86	-1.73	1.0
				11/27/2013	406	1.42	1.16	0.26	1.0
				7/30/2015	758	24.0	1.36	22.6	1.0
				8/9/2017	766	22.8	1.36	21.4	1.0
				8/11/2017	1121	15.8	1.58	14.2	1.0
				6/25/2013	1477	71.5	1.54	70.0	1.0
				10/1/2014	1777	3.36	1.50	1.86	1.0
SM-AI	488,566	1,543,748	1	7/30/2015	136	2.39	2.57	-0.18	1.0
				7/31/2017	514	1.10	1.77	-0.67	1.0
				7/19/2014	869	0.86	1.70	-0.84	1.0
				8/10/2016	1583	15.2	0.50	14.7	1.0
SO-AI	488,381	1,543,652	1	11/15/2013	514	5.10	1.34	3.76	1.0
				7/19/2014	869	4.14	1.04	3.10	1.0
				8/2/2016	1583	3.59	0.26	3.33	1.0
SQ-AI	488,814	1,543,507	1	6/19/2014	893	73.2	11.7	61.5	1.0
SS-AI	488,666	1,543,374	1	7/2/2015	16	0.34	1.26	-0.92	1.0
ST-AI	488,688	1,543,215	1	7/6/2017	16	16.0	11.7	4.28	1.0
				3/20/2013	327	19.0	2.14	16.9	1.0
				6/18/2013	893	52.6	2.44	50.2	1.0
				10/4/2014	1121	0.63	2.87	-2.24	1.0
				3/20/2015	1484	0.58	1.77	-1.19	1.0
				8/20/2015	1542	0.38	1.73	-1.35	1.0
SUB1-AI	489,100	1,537,620	1	5/7/2016	121	<0.03	0.00	0.03	1.0
				3/20/2017	1759	<0.03	0.00	0.03	1.0
SUB2-AI	490,370	1,537,392	1	8/14/2017	120	<0.03	0.00	0.03	1.0
				8/17/2017	309	<0.03	0.00	0.03	1.0
				12/4/2013	514	<0.03	0.00	0.03	1.0
				10/2/2014	862	<0.03	0.00	0.03	1.0
				7/3/2015	1024	<0.03	0.00	0.03	1.0

Table E-1. Groundwater Transport Model Molybdenum Calibration Data

Well ID	Easting	Northing	Model Layer	Date	Model Time (days)	Measured Molybdenum Concentration (mg/L)	Simulated Molybdenum Concentration (mg/L)	Residual (mg/L)	Weight
				12/21/2016	1396	<0.03	0.00	0.03	1.0
				6/29/2017	1612	<0.03	0.00	0.03	1.0
SUB3-AI	489,420	1,538,280	1	12/4/2013	120	<0.03	0.00	0.03	1.0
				10/2/2014	310	<0.03	0.00	0.03	1.0
				7/3/2015	514	<0.03	0.00	0.03	1.0
				12/21/2016	834	<0.03	0.00	0.03	1.0
				6/29/2017	1038	<0.03	0.00	0.03	1.0
				10/2/2014	1613	<0.03	0.00	0.03	1.0
				7/2/2015	1759	<0.03	0.00	0.03	1.0
SV-AI	488,813	1,543,676	1	6/29/2017	327	37.7	10.5	27.2	1.0
				10/2/2014	893	66.3	13.5	52.8	1.0
				7/18/2015	1541	10.8	2.89	7.91	1.0
SW-AI	488,812	1,543,783	1	7/31/2017	514	16.5	9.66	6.84	1.0
				10/2/2014	863	28.7	13.3	15.4	1.0
				7/1/2015	1583	1.98	2.62	-0.64	1.0
SZ-AI	488,833	1,544,367	1	10/9/2016	17	99.4	81.5	17.9	1.0
				6/29/2017	406	93.4	47.0	46.4	1.0
				11/20/2013	766	77.0	40.0	37.0	1.0
				10/2/2014	1124	79.3	38.8	40.5	1.0
				7/21/2015	1476	2.80	7.91	-5.11	1.0
T10-AI	492,791	1,543,434	1	8/10/2016	688	104	29.0	75.0	1.0
				7/31/2017	939	103	20.8	82.2	1.0
				6/18/2013	1675	96.4	8.20	88.2	1.0
T11-AI	489,887	1,544,585	1	11/15/2013	681	6.02	25.4	-19.4	1.0
				10/11/2014	939	22.2	26.8	-4.59	1.0
				8/19/2015	1548	26.3	6.00	20.3	1.0
T12-AI	490,317	1,544,583	1	8/10/2016	121	4.01	6.98	-2.97	1.0
				8/25/2016	681	4.49	11.0	-6.51	1.0
				3/21/2017	939	5.24	13.3	-8.08	1.0
T14-AI	491,071	1,544,565	1	8/14/2017	695	56.9	39.4	17.5	1.0
T15-AI	491,953	1,544,480	1	12/4/2013	695	27.6	30.2	-2.60	1.0
				10/2/2014	890	40.4	28.4	12.0	1.0
T16-AI	492,718	1,544,276	1	7/18/2015	694	77.4	52.1	25.3	1.0
				12/21/2016	866	77.3	46.9	30.4	1.0

Table E-1. Groundwater Transport Model Molybdenum Calibration Data

Well ID	Easting	Northing	Model Layer	Date	Model Time (days)	Measured Molybdenum Concentration (mg/L)	Simulated Molybdenum Concentration (mg/L)	Residual (mg/L)	Weight
T17-AI	489,430	1,544,008	1	8/1/2017	681	63.9	42.8	21.1	1.0
				5/7/2013	865	63.6	40.3	23.3	1.0
T18-AI	490,333	1,543,977	1	11/6/2013	681	11.2	12.0	-0.76	1.0
				5/15/2014	866	3.69	11.6	-7.93	1.0
T19-AI	490,722	1,543,958	1	11/6/2014	681	19.4	10.5	8.88	1.0
				2/18/2015	866	8.69	10.1	-1.38	1.0
				5/2/2015	1773	16.3	10.4	5.94	1.0
T20-AI	491,048	1,543,935	1	8/8/2015	904	11.8	9.01	2.79	1.0
				10/9/2015	1805	18.3	11.4	6.90	1.0
T21-AI	491,882	1,543,951	1	2/16/2016	121	20.4	21.4	-0.97	1.0
				5/5/2016	689	17.9	23.5	-5.58	1.0
				7/10/2016	890	22.9	23.7	-0.78	1.0
				10/18/2016	1805	29.1	26.0	3.13	1.0
T22-AI	492,311	1,543,876	1	5/7/2013	689	1.85	37.5	-35.7	1.0
				11/5/2013	891	2.40	36.8	-34.4	1.0
				5/15/2014	939	3.58	36.7	-33.1	1.0
T23-AI	492,805	1,543,901	1	11/6/2014	695	79.8	47.6	32.2	1.0
				2/18/2015	891	70.8	39.3	31.5	1.0
T2-AI	489,303	1,543,538	1	5/2/2015	326	21.6	31.5	-9.95	1.0
				8/8/2015	687	20.6	30.7	-10.1	1.0
				10/9/2015	939	26.0	27.6	-1.61	1.0
				2/16/2016	1806	59.9	25.5	34.5	1.0
T36-AI	489,688	1,543,735	1	5/5/2016	864	13.4	11.9	1.48	1.0
T39-AI	491,669	1,544,498	1	7/10/2016	695	11.2	25.5	-14.3	1.0
				10/18/2016	890	18.2	24.6	-6.35	1.0
T40-AI	491,466	1,543,819	1	2/16/2017	891	37.8	12.5	25.3	1.0
				5/2/2017	1806	21.5	20.1	1.36	1.0
T41-AI	491,079	1,543,278	1	7/18/2017	687	13.4	5.81	7.59	1.0
				10/25/2017	865	17.9	5.80	12.1	1.0
T4-AI	489,699	1,543,340	1	11/20/2017	121	12.2	11.5	0.69	1.0
				7/9/2014	688	11.4	9.65	1.75	1.0
				10/9/2014	939	14.7	8.96	5.74	1.0
T5-AI	490,289	1,543,307	1	10/16/2015	688	35.1	9.60	25.5	1.0
				5/4/2017	939	25.0	9.07	15.9	1.0

Table E-1. Groundwater Transport Model Molybdenum Calibration Data

Well ID	Easting	Northing	Model Layer	Date	Model Time (days)	Measured Molybdenum Concentration (mg/L)	Simulated Molybdenum Concentration (mg/L)	Residual (mg/L)	Weight
T6-AI	490,655	1,543,282	1	10/10/2014	869	19.0	7.67	11.3	1.0
T7-AI	491,484	1,543,272	1	1/27/2016	869	59.8	13.3	46.5	1.0
T8-AI	491,914	1,543,296	1	10/14/2015	865	32.3	33.7	-1.44	1.0
T9-AI	492,337	1,543,347	1	2/20/2014	689	58.5	39.4	19.1	1.0
				11/18/2014	939	38.2	30.1	8.09	1.0
TA-AI	492,426	1,542,471	1	2/18/2015	1003	2.29	1.22	1.07	1.0
				5/1/2015	1369	2.02	0.70	1.32	1.0
				8/8/2015	1729	3.50	0.35	3.15	1.0
T-AI	492,260	1,542,536	1	10/9/2015	893	5.18	2.05	3.13	1.0
				12/11/2015	1003	8.49	1.94	6.55	1.0
				1/27/2016	1369	5.45	1.42	4.03	1.0
				2/26/2016	1729	4.03	0.83	3.20	1.0
TB-AI	492,616	1,542,351	1	9/16/2016	1004	0.49	0.33	0.16	1.0
				10/19/2016	1729	1.93	0.06	1.87	1.0
X-AI	491,892	1,540,512	1	12/19/2014	43	0.07	0.08	-0.01	1.0
				2/18/2015	110	0.11	0.08	0.03	1.0
				5/1/2015	190	0.08	0.08	0.00	1.0
				8/8/2015	305	0.21	0.07	0.14	1.0
				8/11/2015	407	0.07	0.06	0.01	1.0
				10/9/2015	477	0.07	0.05	0.02	1.0
				2/20/2016	557	0.05	0.05	0.00	1.0
				9/2/2016	569	0.06	0.05	0.01	1.0
				10/18/2016	765	0.16	0.05	0.11	1.0
				2/16/2017	822	0.12	0.05	0.07	1.0
				5/2/2017	927	0.11	0.04	0.07	1.0
				6/27/2017	1012	0.08	0.04	0.04	1.0
				7/18/2017	1135	0.06	0.03	0.03	1.0
				10/23/2017	1198	0.07	0.03	0.04	1.0
				6/25/2015	1286	0.10	0.02	0.08	1.0
				5/11/2016	1390	0.13	0.02	0.11	1.0
				10/23/2014	1520	0.10	0.01	0.09	1.0
				10/1/2015	1581	0.10	0.01	0.09	1.0
				12/15/2016	1659	0.08	0.01	0.07	1.0
				7/6/2016	1759	0.08	0.01	0.07	1.0

Table E-1. Groundwater Transport Model Molybdenum Calibration Data

Well ID	Easting	Northing	Model Layer	Date	Model Time (days)	Measured Molybdenum Concentration (mg/L)	Simulated Molybdenum Concentration (mg/L)	Residual (mg/L)	Weight
				7/12/2016	1792	0.09	0.01	0.08	1.0
0494-UC	489,494	1,536,689	4	2/14/2014	39	0.04	0.04	0.00	1.0
				8/27/2014	189	0.05	0.04	0.01	1.0
				2/20/2015	408	0.05	0.05	0.00	1.0
				2/12/2016	532	0.09	0.05	0.04	1.0
				3/27/2017	793	0.05	0.05	0.00	1.0
				2/7/2013	871	0.04	0.05	-0.01	1.0
				8/9/2013	1142	<0.03	0.04	-0.01	1.0
				2/14/2014	1290	0.04	0.04	0.00	1.0
				2/20/2015	1520	0.06	0.04	0.02	1.0
				3/27/2017	1639	0.06	0.04	0.02	1.0
0929-UC	495,585	1,544,684	4	5/15/2013	57	<0.03	0.00	0.03	1.0
				2/6/2015	641	<0.03	0.00	0.03	1.0
				3/28/2017	912	<0.03	0.00	0.03	1.0
0931-UC	495,207	1,542,461	4	5/1/2017	641	<0.03	0.00	0.03	1.0
				11/24/2013	912	<0.03	0.00	0.03	1.0
				6/13/2015	1646	<0.03	0.00	0.03	1.0
AW-UC	488,015	1,540,235	4	11/23/2013	344	0.11	0.03	0.08	1.0
				2/12/2014	648	0.06	0.02	0.04	1.0
				5/15/2014	1027	0.06	0.02	0.04	1.0
				8/6/2014	1449	0.05	0.02	0.03	1.0
				12/12/2014	1794	0.06	0.02	0.04	1.0
CE10-UC	490,177	1,541,737	4	6/12/2015	247	1.76	1.44	0.32	1.0
				7/17/2015	569	1.82	1.44	0.38	1.0
				1/21/2016	927	3.49	1.36	2.13	1.0
				7/19/2016	1660	2.19	1.24	0.95	1.0
CE11-UC	490,494	1,541,486	4	1/6/2017	56	1.70	1.78	-0.08	1.0
				3/31/2017	947	3.13	1.90	1.23	1.0
				7/18/2017	1295	2.56	1.78	0.78	1.0
				11/6/2017	1501	3.20	1.67	1.53	1.0
				1/16/2013	1660	0.15	1.64	-1.49	1.0
CE12-UC	489,642	1,541,867	4	11/1/2013	56	2.83	1.62	1.21	1.0
				1/28/2014	570	2.03	0.66	1.37	1.0
				9/18/2014	638	2.14	0.65	1.49	1.0

Table E-1. Groundwater Transport Model Molybdenum Calibration Data

Well ID	Easting	Northing	Model Layer	Date	Model Time (days)	Measured Molybdenum Concentration (mg/L)	Simulated Molybdenum Concentration (mg/L)	Residual (mg/L)	Weight
				6/12/2015	947	5.74	0.76	4.98	1.0
				7/17/2015	1295	1.65	0.57	1.08	1.0
				1/19/2016	1540	1.06	0.41	0.65	1.0
				7/19/2016	1660	1.23	0.40	0.83	1.0
CE13-UC	490,338	1,542,693	4	1/6/2017	570	22.7	20.0	2.75	1.0
				3/31/2017	640	25.2	18.7	6.54	1.0
				7/18/2017	928	27.7	16.8	10.9	1.0
				11/7/2017	1661	29.1	14.3	14.8	1.0
CE14-UC	489,600	1,541,326	4	1/16/2013	65	<0.03	0.02	0.01	1.0
				11/1/2013	248	<0.03	0.02	0.01	1.0
				1/28/2014	640	<0.03	0.03	0.00	1.0
				9/18/2014	821	<0.03	0.04	-0.01	1.0
				2/5/2015	970	<0.03	0.04	-0.01	1.0
				6/12/2015	1174	0.04	0.05	-0.01	1.0
				7/17/2015	1540	<0.03	0.02	0.01	1.0
CE15-UC	489,460	1,539,507	4	1/19/2016	65	0.24	0.26	-0.02	1.0
				7/19/2016	247	0.24	0.27	-0.03	1.0
				1/6/2017	640	0.25	0.34	-0.09	1.0
				3/31/2017	821	0.38	0.37	0.01	1.0
				7/18/2017	1174	0.93	0.41	0.52	1.0
				11/6/2017	1540	0.41	0.41	0.00	1.0
CE2-UC	489,979	1,541,923	4	1/16/2013	56	2.17	1.86	0.31	1.0
				11/1/2013	638	3.19	1.59	1.60	1.0
				1/28/2014	862	4.05	1.42	2.63	1.0
				9/18/2014	1019	1.09	1.27	-0.18	1.0
				6/12/2015	1227	1.17	1.22	-0.05	1.0
				7/17/2015	1395	1.04	1.24	-0.20	1.0
				1/22/2016	1582	1.41	1.24	0.17	1.0
				7/19/2016	1639	2.19	1.24	0.95	1.0
				1/6/2017	1659	1.40	1.24	0.16	1.0
				3/31/2017	1758	1.61	1.24	0.37	1.0
CE5-UC	490,695	1,541,453	4	7/18/2017	56	0.30	0.74	-0.44	1.0
				11/6/2017	638	2.84	0.37	2.47	1.0
				1/16/2013	928	2.47	0.22	2.25	1.0

Table E-1. Groundwater Transport Model Molybdenum Calibration Data

Well ID	Easting	Northing	Model Layer	Date	Model Time (days)	Measured Molybdenum Concentration (mg/L)	Simulated Molybdenum Concentration (mg/L)	Residual (mg/L)	Weight
				11/1/2013	1293	1.13	0.30	0.83	1.0
				1/28/2014	1501	2.06	0.27	1.79	1.0
				9/18/2014	1660	0.14	0.21	-0.07	1.0
CE6-UC	490,433	1,541,698	4	2/5/2015	56	2.35	2.01	0.34	1.0
				6/12/2015	638	2.87	2.08	0.79	1.0
				7/17/2015	928	3.64	2.17	1.47	1.0
				1/19/2016	1295	1.56	2.02	-0.46	1.0
				7/19/2016	1501	2.50	1.89	0.61	1.0
				1/6/2017	1660	1.40	1.85	-0.45	1.0
CE7-UC	490,079	1,542,652	4	3/31/2017	189	32.7	17.3	15.4	1.0
				11/7/2017	815	30.9	17.6	13.3	1.0
				7/22/2015	893	30.2	17.6	12.6	1.0
				3/28/2017	1661	7.87	12.2	-4.35	1.0
CE8-UC	491,556	1,540,704	4	12/24/2014	59	0.09	0.07	0.02	1.0
				10/17/2015	247	0.07	0.07	0.00	1.0
				10/27/2016	570	0.07	0.07	0.00	1.0
				5/1/2017	808	0.05	0.07	-0.02	1.0
				10/23/2017	960	0.04	0.07	-0.03	1.0
				12/24/2014	998	0.04	0.07	-0.03	1.0
				11/19/2015	1137	0.06	0.06	0.00	1.0
				5/1/2017	1358	<0.03	0.02	0.01	1.0
				10/23/2017	1521	<0.03	0.01	0.02	1.0
				12/24/2014	1778	<0.03	0.01	0.02	1.0
CE9-UC	489,458	1,538,203	4	10/17/2015	59	0.06	0.06	0.00	1.0
				10/27/2016	648	0.06	0.06	0.00	1.0
				5/1/2017	815	0.08	0.06	0.02	1.0
				10/23/2017	961	0.18	0.07	0.11	1.0
				12/24/2014	1170	0.24	0.07	0.17	1.0
				11/19/2015	1540	0.22	0.06	0.16	1.0
				5/1/2017	1660	0.12	0.06	0.06	1.0
				10/23/2017	1686	0.10	0.06	0.04	1.0
CF1-UC	491,868	1,544,456	4	12/24/2014	64	1.74	2.01	-0.27	1.0
				10/17/2015	326	4.07	2.02	2.05	1.0
				10/27/2016	639	3.99	2.03	1.96	1.0

Table E-1. Groundwater Transport Model Molybdenum Calibration Data

Well ID	Easting	Northing	Model Layer	Date	Model Time (days)	Measured Molybdenum Concentration (mg/L)	Simulated Molybdenum Concentration (mg/L)	Residual (mg/L)	Weight
				5/1/2017	1641	3.47	2.07	1.40	1.0
CF2-UC	490,888	1,544,358	4	12/24/2014	64	1.30	1.27	0.03	1.0
				11/19/2015	640	0.72	1.38	-0.66	1.0
				5/1/2017	1641	0.41	1.57	-1.16	1.0
CW18-UC	491,378	1,535,924	4	11/24/2013	57	<0.03	0.00	0.03	1.0
				6/12/2015	641	<0.03	0.00	0.03	1.0
				3/23/2017	820	<0.03	0.00	0.03	1.0
				12/4/2013	1333	<0.03	0.00	0.03	1.0
				7/29/2015	1539	<0.03	0.00	0.03	1.0
				5/15/2013	1689	<0.03	0.00	0.03	1.0
CW3-UC	493,496	1,545,200	4	5/16/2013	59	0.28	0.33	-0.05	1.0
				5/16/2013	641	0.44	0.43	0.01	1.0
				3/25/2015	912	0.33	0.49	-0.16	1.0
				5/16/2013	1792	0.30	0.02	0.28	1.0
CW40-UC	491,819	1,537,624	4	3/24/2017	912	<0.03	0.00	0.03	1.0
				5/15/2013	1641	<0.03	0.00	0.03	1.0
CW50-UC	491,159	1,546,687	4	5/1/2015	331	<0.03	0.00	0.03	1.0
				5/18/2016	639	<0.03	0.00	0.03	1.0
				10/7/2016	799	<0.03	0.00	0.03	1.0
				10/27/2016	961	<0.03	0.00	0.03	1.0
				3/23/2017	1171	<0.03	0.00	0.03	1.0
				5/3/2017	1539	<0.03	0.00	0.03	1.0
				6/1/2017	1683	<0.03	0.00	0.03	1.0
CW53-UC	490,262	1,536,668	4	12/5/2017	319	<0.03	0.00	0.03	1.0
				5/14/2013	471	<0.03	0.00	0.03	1.0
				3/27/2015	619	<0.03	0.00	0.03	1.0
				5/13/2015	1228	<0.03	0.00	0.03	1.0
				5/18/2016	1391	0.04	0.00	0.04	1.0
				10/27/2016	1583	<0.03	0.00	0.03	1.0
CW9-UC	491,015	1,542,840	4	3/22/2017	640	<0.03	4.32	-4.29	1.0
				11/13/2017	1641	0.06	4.32	-4.26	1.0
0481-MC	490,210	1,536,820	6	3/17/2017	131	<0.03	0.00	0.03	1.0
				6/27/2017	527	<0.03	0.00	0.03	1.0
0482-MC	489,579	1,536,981	6	6/10/2015	191	0.06	0.05	0.01	1.0

Table E-1. Groundwater Transport Model Molybdenum Calibration Data

Well ID	Easting	Northing	Model Layer	Date	Model Time (days)	Measured Molybdenum Concentration (mg/L)	Simulated Molybdenum Concentration (mg/L)	Residual (mg/L)	Weight
				7/6/2016	499	0.06	0.04	0.02	1.0
0483-MC	489,753	1,536,586	6	10/14/2015	319	0.04	0.03	0.01	1.0
				3/21/2013	528	0.05	0.03	0.02	1.0
				10/23/2014	619	0.05	0.03	0.02	1.0
				10/1/2015	1229	0.05	0.03	0.02	1.0
0493-MC	489,492	1,536,702	6	12/29/2016	39	<0.03	0.00	0.03	1.0
				2/7/2013	189	<0.03	0.00	0.03	1.0
				8/9/2013	408	<0.03	0.00	0.03	1.0
				2/14/2014	408	<0.03	0.00	0.03	1.0
				8/28/2014	532	<0.03	0.00	0.03	1.0
				2/20/2015	793	<0.03	0.00	0.03	1.0
				2/12/2016	793	<0.03	0.00	0.03	1.0
				2/24/2017	871	<0.03	0.00	0.03	1.0
				3/28/2017	1142	<0.03	0.00	0.03	1.0
				2/7/2013	1288	<0.03	0.00	0.03	1.0
0498-MC	488,953	1,534,661	6	8/9/2013	1520	<0.03	0.00	0.03	1.0
				2/26/2015	319	<0.03	0.00	0.03	1.0
				2/11/2016	528	<0.03	0.00	0.03	1.0
				3/27/2017	891	<0.03	0.00	0.03	1.0
				3/7/2013	1283	<0.03	0.00	0.03	1.0
0859-MC	487,426	1,534,549	6	4/2/2014	1696	<0.03	0.00	0.03	1.0
				10/6/2017	323	<0.03	0.00	0.03	1.0
0930-MC	494,997	1,542,848	6	5/1/2013	535	<0.03	0.00	0.03	1.0
				6/13/2015	641	<0.03	0.00	0.03	1.0
				5/2/2017	912	<0.03	0.00	0.03	1.0
ACW-MC	488,070	1,540,235	6	6/13/2015	1646	<0.03	0.00	0.03	1.0
				10/8/2016	344	<0.03	0.00	0.03	1.0
				3/1/2017	648	<0.03	0.00	0.03	1.0
				5/2/2017	1027	<0.03	0.00	0.03	1.0
				8/8/2017	1449	<0.03	0.00	0.03	1.0
CW15-MC	485,961	1,536,259	6	10/12/2017	1794	0.01	0.00	0.01	1.0
				10/23/2017	640	<0.03	0.00	0.03	1.0
				12/24/2014	911	<0.03	0.00	0.03	1.0
				10/27/2016	1641	<0.03	0.00	0.03	1.0

Table E-1. Groundwater Transport Model Molybdenum Calibration Data

Well ID	Easting	Northing	Model Layer	Date	Model Time (days)	Measured Molybdenum Concentration (mg/L)	Simulated Molybdenum Concentration (mg/L)	Residual (mg/L)	Weight
CW17-MC	487,771	1,545,279	6	5/1/2017	175	0.66	0.71	-0.05	1.0
				10/23/2017	331	0.53	0.73	-0.20	1.0
				5/15/2013	639	0.43	0.74	-0.31	1.0
				3/17/2016	913	0.34	0.78	-0.44	1.0
				3/24/2017	1447	0.11	0.79	-0.68	1.0
				10/2/2015	1640	0.08	0.17	-0.09	1.0
				9/19/2017	1756	0.06	0.11	-0.05	1.0
CW1-MC	490,295	1,545,235	6	3/4/2015	59	<0.03	0.00	0.03	1.0
				3/24/2017	912	<0.03	0.00	0.03	1.0
CW24-MC	487,760	1,545,773	6	3/21/2013	948	<0.03	0.00	0.03	1.0
				3/4/2015	1672	<0.03	0.00	0.03	1.0
CW28-MC	491,008	1,535,112	6	3/17/2016	57	<0.03	0.00	0.03	1.0
				2/21/2013	641	<0.03	0.00	0.03	1.0
				11/24/2013	913	<0.03	0.00	0.03	1.0
				12/18/2013	1806	0.02	0.00	0.02	1.0
CW2-MC	491,302	1,545,212	6	11/2/2013	42	<0.03	0.00	0.03	1.0
				3/20/2014	59	<0.03	0.00	0.03	1.0
				3/13/2015	309	<0.03	0.00	0.03	1.0
				10/16/2015	408	<0.03	0.00	0.03	1.0
				3/16/2016	613	<0.03	0.00	0.03	1.0
				10/27/2016	912	<0.03	0.00	0.03	1.0
				3/17/2017	949	<0.03	0.00	0.03	1.0
				2/21/2013	1137	<0.03	0.00	0.03	1.0
				11/24/2013	1365	<0.03	0.00	0.03	1.0
				9/30/2014	1540	<0.03	0.00	0.03	1.0
				3/4/2015	1682	<0.03	0.00	0.03	1.0
CW44-MC	488,891	1,535,048	6	3/23/2017	319	<0.03	0.00	0.03	1.0
				2/21/2013	528	<0.03	0.00	0.03	1.0
				4/1/2015	618	<0.03	0.00	0.03	1.0
				3/23/2017	940	<0.03	0.00	0.03	1.0
				2/21/2013	1283	<0.03	0.00	0.03	1.0
				10/4/2014	1432	<0.03	0.00	0.03	1.0
CW45-MC	489,494	1,535,036	6	4/1/2015	65	<0.03	0.00	0.03	1.0
				3/23/2017	168	<0.03	0.00	0.03	1.0

Table E-1. Groundwater Transport Model Molybdenum Calibration Data

Well ID	Easting	Northing	Model Layer	Date	Model Time (days)	Measured Molybdenum Concentration (mg/L)	Simulated Molybdenum Concentration (mg/L)	Residual (mg/L)	Weight
				5/8/2013	319	<0.03	0.00	0.03	1.0
				11/6/2013	683	<0.03	0.00	0.03	1.0
				5/15/2014	722	<0.03	0.00	0.03	1.0
				5/20/2015	820	<0.03	0.00	0.03	1.0
				10/21/2015	820	<0.03	0.00	0.03	1.0
				5/17/2016	961	<0.03	0.00	0.03	1.0
				9/14/2017	1159	<0.03	0.00	0.03	1.0
				10/26/2017	1335	<0.03	0.00	0.03	1.0
				5/14/2013	1543	<0.03	0.00	0.03	1.0
				3/27/2015	1687	<0.03	0.00	0.03	1.0
CW55-MC	489,471	1,538,283	6	5/3/2017	337	0.04	0.00	0.04	1.0
				12/4/2017	649	0.04	0.00	0.04	1.0
				12/4/2013	941	0.06	0.00	0.06	1.0
				1/16/2017	1806	0.07	0.00	0.07	1.0
CW56-MC	488,115	1,545,279	6	10/13/2017	121	3.65	3.36	0.29	1.0
				1/17/2013	219	3.29	3.37	-0.08	1.0
				2/11/2014	639	2.81	3.23	-0.42	1.0
				2/6/2015	782	2.45	3.23	-0.78	1.0
				4/11/2015	970	2.20	3.22	-1.02	1.0
				1/15/2013	1447	0.54	2.97	-2.43	1.0
				7/10/2013	1688	0.38	2.85	-2.47	1.0
				1/22/2014	1757	0.31	2.82	-2.51	1.0
CW57-MC	488,070	1,545,654	6	7/11/2014	130	<0.03	0.00	0.03	1.0
				1/30/2015	638	<0.03	0.00	0.03	1.0
				7/17/2015	781	<0.03	0.00	0.03	1.0
				1/20/2016	973	<0.03	0.00	0.03	1.0
				7/10/2016	1757	<0.03	0.00	0.03	1.0
CW60-MC	488,262	1,545,470	6	1/13/2017	130	<0.03	0.00	0.03	1.0
				7/18/2017	638	<0.03	0.01	0.02	1.0
				4/11/2015	781	<0.03	0.01	0.02	1.0
				7/30/2015	973	<0.03	0.01	0.02	1.0
				7/19/2017	1688	<0.03	0.01	0.02	1.0
				3/5/2013	1757	<0.03	0.01	0.02	1.0
CW61-MC	487,779	1,544,927	6	7/10/2013	130	4.02	3.35	0.67	1.0

Table E-1. Groundwater Transport Model Molybdenum Calibration Data

Well ID	Easting	Northing	Model Layer	Date	Model Time (days)	Measured Molybdenum Concentration (mg/L)	Simulated Molybdenum Concentration (mg/L)	Residual (mg/L)	Weight
				3/20/2014	638	3.34	3.30	0.04	1.0
				7/11/2014	820	3.43	3.28	0.15	1.0
				7/23/2014	971	3.62	3.26	0.36	1.0
				7/17/2015	1446	1.65	3.21	-1.56	1.0
				1/29/2016	1688	1.39	3.16	-1.77	1.0
CW62-MC	487,847	1,544,555	6	3/16/2016	134	2.35	2.28	0.07	1.0
				7/10/2016	638	2.02	1.96	0.06	1.0
				3/14/2017	820	2.23	1.94	0.29	1.0
				7/18/2017	971	2.37	1.92	0.45	1.0
				11/13/2017	1234	1.62	1.80	-0.18	1.0
				11/24/2013	1431	0.89	1.71	-0.82	1.0
				6/12/2015	1444	1.13	1.70	-0.57	1.0
				3/23/2017	1501	0.83	1.69	-0.86	1.0
				4/18/2015	1583	0.88	1.68	-0.80	1.0
				6/12/2015	1688	0.84	1.66	-0.82	1.0
				1/20/2016	1793	0.79	1.63	-0.84	1.0
CW6-MC	488,301	1,542,588	6	1/29/2016	638	<0.03	0.00	0.03	1.0
WCW-MC	488,520	1,541,045	6	2/10/2017	331	<0.03	0.00	0.03	1.0
				2/17/2017	941	<0.03	0.00	0.03	1.0
				2/28/2017	1681	0.06	0.00	0.06	1.0
				5/3/2017	1683	<0.03	0.00	0.03	1.0
WR25-MC	487,430	1,545,267	6	5/11/2017	176	<0.03	0.01	0.02	1.0
				7/19/2017	639	<0.03	0.01	0.02	1.0
				8/28/2017	940	<0.03	0.02	0.01	1.0
				3/7/2013	1672	<0.03	0.03	0.00	1.0
0538-LC	486,899	1,533,486	8	9/30/2015	564	<0.03	0.00	0.03	1.0
				1/12/2016	1318	<0.03	0.00	0.03	1.0
0653-LC	486,570	1,533,283	8	2/26/2014	319	<0.03	0.00	0.03	1.0
				9/4/2014	564	<0.03	0.00	0.03	1.0
				3/18/2015	1310	<0.03	0.00	0.03	1.0
0853-LC	484,824	1,532,124	8	3/25/2015	535	<0.03	0.00	0.03	1.0
				2/10/2016	912	<0.03	0.00	0.03	1.0
				3/28/2017	1647	<0.03	0.00	0.03	1.0
CW29-LC	487,435	1,534,551	8	9/30/2014	79	<0.03	0.00	0.03	1.0

Table E-1. Groundwater Transport Model Molybdenum Calibration Data

Well ID	Easting	Northing	Model Layer	Date	Model Time (days)	Measured Molybdenum Concentration (mg/L)	Simulated Molybdenum Concentration (mg/L)	Residual (mg/L)	Weight
				3/4/2015	169	<0.03	0.00	0.03	1.0
				6/12/2015	641	<0.03	0.00	0.03	1.0
				10/2/2015	809	<0.03	0.00	0.03	1.0
				3/17/2016	961	<0.03	0.00	0.03	1.0
				5/15/2013	1222	<0.03	0.00	0.03	1.0
				3/17/2016	1539	<0.03	0.00	0.03	1.0
				3/24/2017	1686	<0.03	0.00	0.03	1.0
				3/5/2013	1689	<0.03	0.00	0.03	1.0
CW31-LC	482,738	1,540,689	8	6/12/2015	338	<0.03	0.00	0.03	1.0
				10/2/2015	639	<0.03	0.00	0.03	1.0
				3/17/2016	913	<0.03	0.00	0.03	1.0
				3/24/2017	1450	<0.03	0.00	0.03	1.0
				9/19/2017	1640	<0.03	0.00	0.03	1.0
CW32-LC	483,523	1,543,413	8	3/11/2015	337	<0.03	0.00	0.03	1.0
				4/15/2015	639	<0.03	0.00	0.03	1.0
				8/8/2015	913	<0.03	0.00	0.03	1.0
				3/16/2016	1450	<0.03	0.00	0.03	1.0
				9/9/2016	1640	<0.03	0.00	0.03	1.0
CW33-LC	486,347	1,543,814	8	3/20/2017	639	<0.03	0.00	0.03	1.0
				5/1/2017	913	<0.03	0.00	0.03	1.0
				8/11/2017	1640	<0.03	0.00	0.03	1.0
CW36-LC	481,329	1,540,053	8	10/13/2017	639	<0.03	0.00	0.03	1.0
				5/1/2013	928	<0.03	0.00	0.03	1.0
				11/24/2013	1672	<0.03	0.00	0.03	1.0
CW37-LC	484,853	1,537,240	8	7/1/2016	640	<0.03	0.00	0.03	1.0
				3/29/2017	911	<0.03	0.00	0.03	1.0
				7/19/2017	1378	<0.03	0.00	0.03	1.0
				12/1/2017	1640	<0.03	0.00	0.03	1.0
CW41-LC	488,583	1,533,174	8	3/11/2015	323	<0.03	0.00	0.03	1.0
				8/19/2015	640	<0.03	0.00	0.03	1.0
				3/16/2016	931	<0.03	0.00	0.03	1.0
				3/20/2017	1318	<0.03	0.00	0.03	1.0
				8/11/2017	1672	<0.03	0.00	0.03	1.0
CW42-LC	487,177	1,533,169	8	11/13/2017	169	<0.03	0.00	0.03	1.0

Table E-1. Groundwater Transport Model Molybdenum Calibration Data

Well ID	Easting	Northing	Model Layer	Date	Model Time (days)	Measured Molybdenum Concentration (mg/L)	Simulated Molybdenum Concentration (mg/L)	Residual (mg/L)	Weight
				12/17/2016	319	<0.03	0.00	0.03	1.0
				11/13/2017	649	<0.03	0.00	0.03	1.0
				5/16/2013	961	<0.03	0.00	0.03	1.0
				3/4/2015	1318	<0.03	0.00	0.03	1.0
				3/17/2016	1333	<0.03	0.00	0.03	1.0
				3/24/2017	1540	<0.03	0.00	0.03	1.0
				8/28/2015	1686	<0.03	0.00	0.03	1.0
CW43-LC	482,493	1,537,587	8	8/21/2017	337	<0.03	0.00	0.03	1.0
				4/15/2015	640	<0.03	0.00	0.03	1.0
				8/27/2015	929	<0.03	0.00	0.03	1.0
				8/16/2017	1451	<0.03	0.00	0.03	1.0
				12/4/2013	1673	<0.03	0.00	0.03	1.0
#1_Deepwell-SA	493,633	1,543,307	10	5/11/2013	126	<0.03	0.00	0.03	1.0
				6/12/2014	310	<0.03	0.00	0.03	1.0
				7/10/2013	500	<0.03	0.00	0.03	1.0
				5/15/2014	674	0.16	0.00	0.16	1.0
				11/15/2013	779	<0.03	0.00	0.03	1.0
				6/12/2014	851	<0.03	0.00	0.03	1.0
				9/11/2014	950	<0.03	0.00	0.03	1.0
				5/13/2016	1011	<0.03	0.00	0.03	1.0
				11/5/2013	1142	<0.03	0.00	0.03	1.0
				11/23/2013	1220	<0.03	0.00	0.03	1.0
				6/12/2014	1286	<0.03	0.00	0.03	1.0
#2_Deepwell-SA	490,972	1,542,424	10	5/22/2015	1386	<0.03	0.00	0.03	1.0
				10/16/2015	126	<0.03	0.00	0.03	1.0
				5/13/2016	309	<0.03	0.00	0.03	1.0
				10/22/2016	500	<0.03	0.00	0.03	1.0
				3/9/2017	674	<0.03	0.00	0.03	1.0
				7/10/2013	779	<0.03	0.00	0.03	1.0
				5/15/2014	851	<0.03	0.00	0.03	1.0
				9/19/2014	950	<0.03	0.00	0.03	1.0
				9/19/2014	1011	<0.03	0.00	0.03	1.0
				3/7/2013	1142	<0.03	0.00	0.03	1.0
				11/15/2013	1220	0.05	0.00	0.05	1.0

Table E-1. Groundwater Transport Model Molybdenum Calibration Data

Well ID	Easting	Northing	Model Layer	Date	Model Time (days)	Measured Molybdenum Concentration (mg/L)	Simulated Molybdenum Concentration (mg/L)	Residual (mg/L)	Weight
				4/2/2014	1286	0.04	0.00	0.04	1.0
				6/18/2013	1386	<0.03	0.00	0.03	1.0
				11/15/2013	1507	<0.03	0.00	0.03	1.0
				4/2/2014	1582	<0.03	0.00	0.03	1.0
				6/12/2014	1659	<0.03	0.00	0.03	1.0
				7/11/2014	1758	<0.03	0.00	0.03	1.0
				11/14/2014	1784	<0.03	0.00	0.03	1.0
0806R-SA	486,263	1,541,177	10	2/12/2013	554	<0.03	0.00	0.03	1.0
				8/9/2013	647	<0.03	0.00	0.03	1.0
				2/12/2014	1018	<0.03	0.00	0.03	1.0
				8/27/2014	1584	<0.03	0.00	0.03	1.0
0806-SA	486,320	1,541,120	10	2/27/2015	647	<0.03	0.00	0.03	1.0
0928-SA	491,700	1,548,250	10	11/13/2017	1121	0.06	0.00	0.06	1.0
0938-SA	473,040	1,539,500	10	6/13/2015	1017	<0.03	0.00	0.03	1.0
0943-SA	487,407	1,537,222	10	5/2/2017	415	<0.03	0.00	0.03	1.0
				6/13/2015	686	<0.03	0.00	0.03	1.0
				5/2/2017	779	<0.03	0.00	0.03	1.0
				6/13/2015	850	<0.03	0.00	0.03	1.0
				5/1/2017	950	<0.03	0.00	0.03	1.0
				6/19/2014	1012	<0.03	0.00	0.03	1.0
				5/22/2015	1075	<0.03	0.00	0.03	1.0
				3/22/2017	1121	<0.03	0.00	0.03	1.0
				6/19/2014	1151	<0.03	0.00	0.03	1.0
				5/22/2015	1354	<0.03	0.00	0.03	1.0
				6/27/2017	1387	<0.03	0.00	0.03	1.0
				3/8/2013	1501	<0.03	0.00	0.03	1.0
				11/1/2013	1508	<0.03	0.00	0.03	1.0
				3/27/2014	1519	<0.03	0.00	0.03	1.0
				9/30/2014	1583	<0.03	0.00	0.03	1.0
				4/1/2015	1591	<0.03	0.00	0.03	1.0
0951R-SA	484,100	1,544,500	10	6/12/2015	1660	<0.03	0.00	0.03	1.0
				10/2/2015	1700	<0.03	0.00	0.03	1.0
				3/16/2016	66	0.08	0.00	0.08	1.0
				9/30/2016	718	0.08	0.00	0.08	1.0

Table E-1. Groundwater Transport Model Molybdenum Calibration Data

Well ID	Easting	Northing	Model Layer	Date	Model Time (days)	Measured Molybdenum Concentration (mg/L)	Simulated Molybdenum Concentration (mg/L)	Residual (mg/L)	Weight
				3/31/2017	779	<0.03	0.00	0.03	1.0
				9/30/2014	850	<0.03	0.00	0.03	1.0
				6/12/2015	950	<0.03	0.00	0.03	1.0
				10/2/2015	953	<0.03	0.00	0.03	1.0
				9/30/2016	1011	<0.03	0.00	0.03	1.0
				3/31/2017	1146	<0.03	0.00	0.03	1.0
				9/20/2017	1341	<0.03	0.00	0.03	1.0
				11/1/2013	1387	<0.03	0.00	0.03	1.0
				6/12/2015	1507	<0.03	0.00	0.03	1.0
				10/2/2015	1582	<0.03	0.00	0.03	1.0
				9/30/2016	1638	<0.03	0.00	0.03	1.0
				3/31/2017	1659	<0.03	0.00	0.03	1.0
				9/20/2017	1756	<0.03	0.00	0.03	1.0
0951-SA	473,200	1,545,500	10	3/8/2013	905	<0.03	0.00	0.03	1.0
				11/1/2013	1226	<0.03	0.00	0.03	1.0
0998-SA	476,450	1,533,080	10	10/2/2015	660	<0.03	0.00	0.03	1.0
				3/31/2017	1003	<0.03	0.00	0.03	1.0
				3/8/2013	1445	0.06	0.00	0.06	1.0
OLD_#1-SA	493,775	1,543,798	10	7/2/2015	1282	<0.03	0.00	0.03	1.0
				12/17/2016	1289	<0.03	0.00	0.03	1.0

Appendix F: Approximated Remedial System Collection and Injection Rates (Electronic)

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Appendix G: Numerical Modeling Files (Electronic)

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